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Shindo et al.

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(54) **CONNECTOR INCLUDING LOCKING STRUCTURE HAVING A LOCKING LUG AND A SPRING PORTION**

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(51) **Int. Cl.**
H01R 13/62 (2006.01)
H01R 12/50 (2011.01)
(Continued)

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CPC ***H01R 23/701*** (2013.01); ***H01R 12/774*** (2013.01); ***H01R 12/79*** (2013.01); ***H01R 13/62994*** (2013.01)
USPC **439/153**

(58) **Field of Classification Search**
USPC 439/352–358, 607.01, 153, 260
See application file for complete search history.

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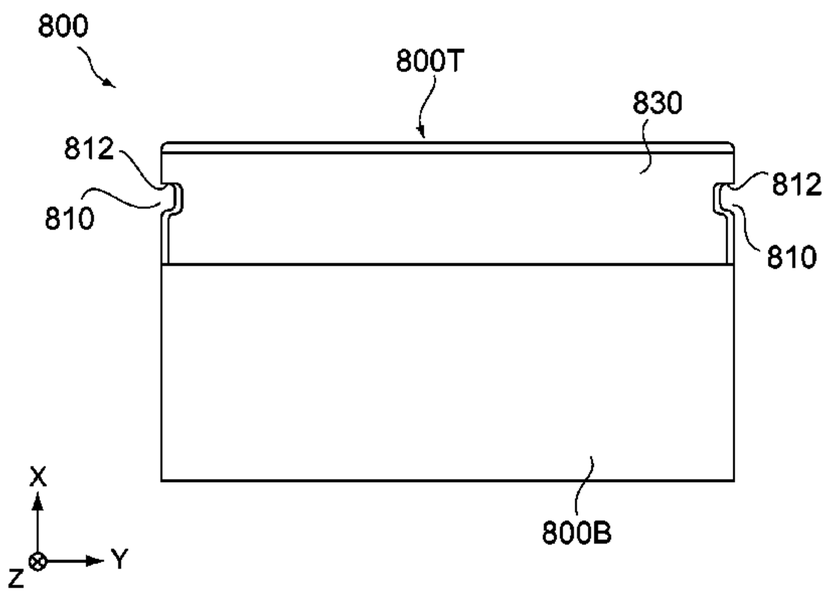
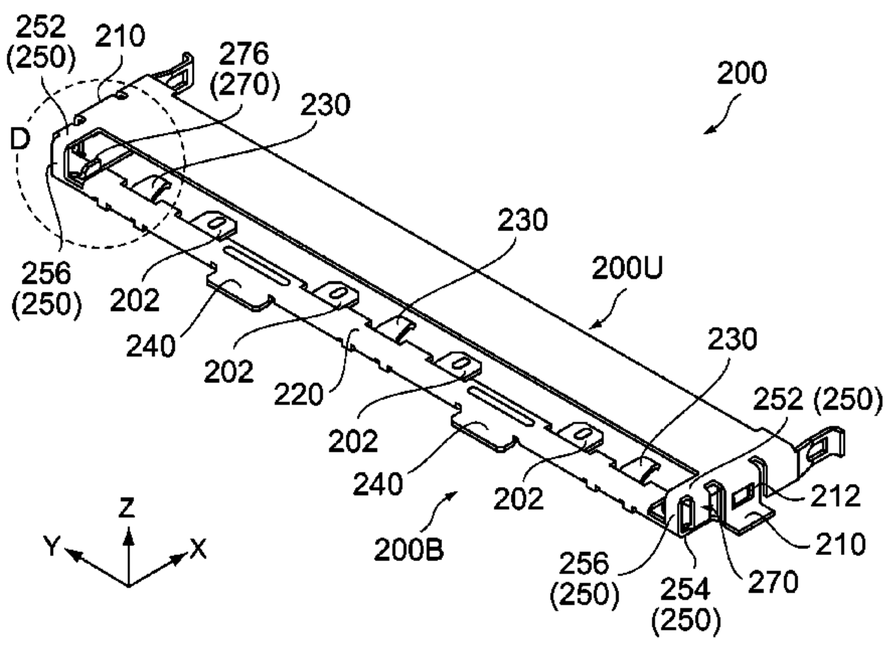
Primary Examiner — Chandrika Prasad
(74) *Attorney, Agent, or Firm* — Holtz, Holtz, Goodman & Chick PC

(57) **ABSTRACT**

Provided is a connector lockable a connection with the connection object securely. The connector comprises a housing, an attachment, and a lock portion. The connection object which has a locked portion is inserted to and connected with the connector from the front of the connector. The attachment is attached to the housing and comprises an upper attachment positioned higher than the housing, a lower attachment positioned lower than the housing, and a coupling portion coupling the upper attachment and the lower attachment. The lock portion comprises a locking lug positioned backward of the coupling portion and engaging with the locked portion of the connection object when the connection object connected with the connector is moved in an eject direction opposite to the insertion direction, and a spring portion positioned between the upper attachment and the lower attachment and supporting the locking lug so as to be displaceable in a vertical direction perpendicular to the insertion direction.

11 Claims, 10 Drawing Sheets





(51) **Int. Cl.**

H01R 12/77	(2011.01)
H01R 12/79	(2011.01)
H01R 13/629	(2006.01)

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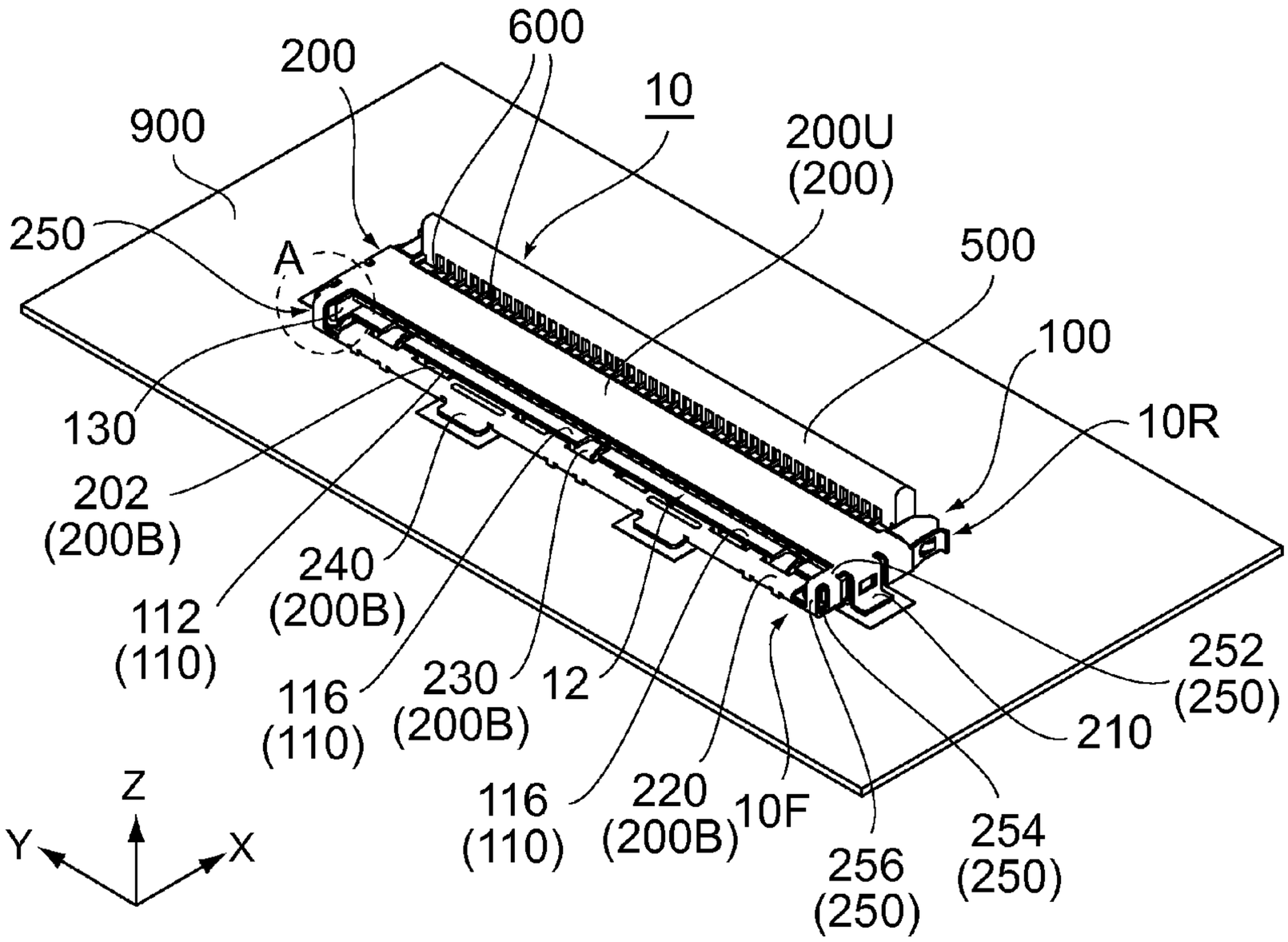
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200
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900
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A
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100
130
10R
202
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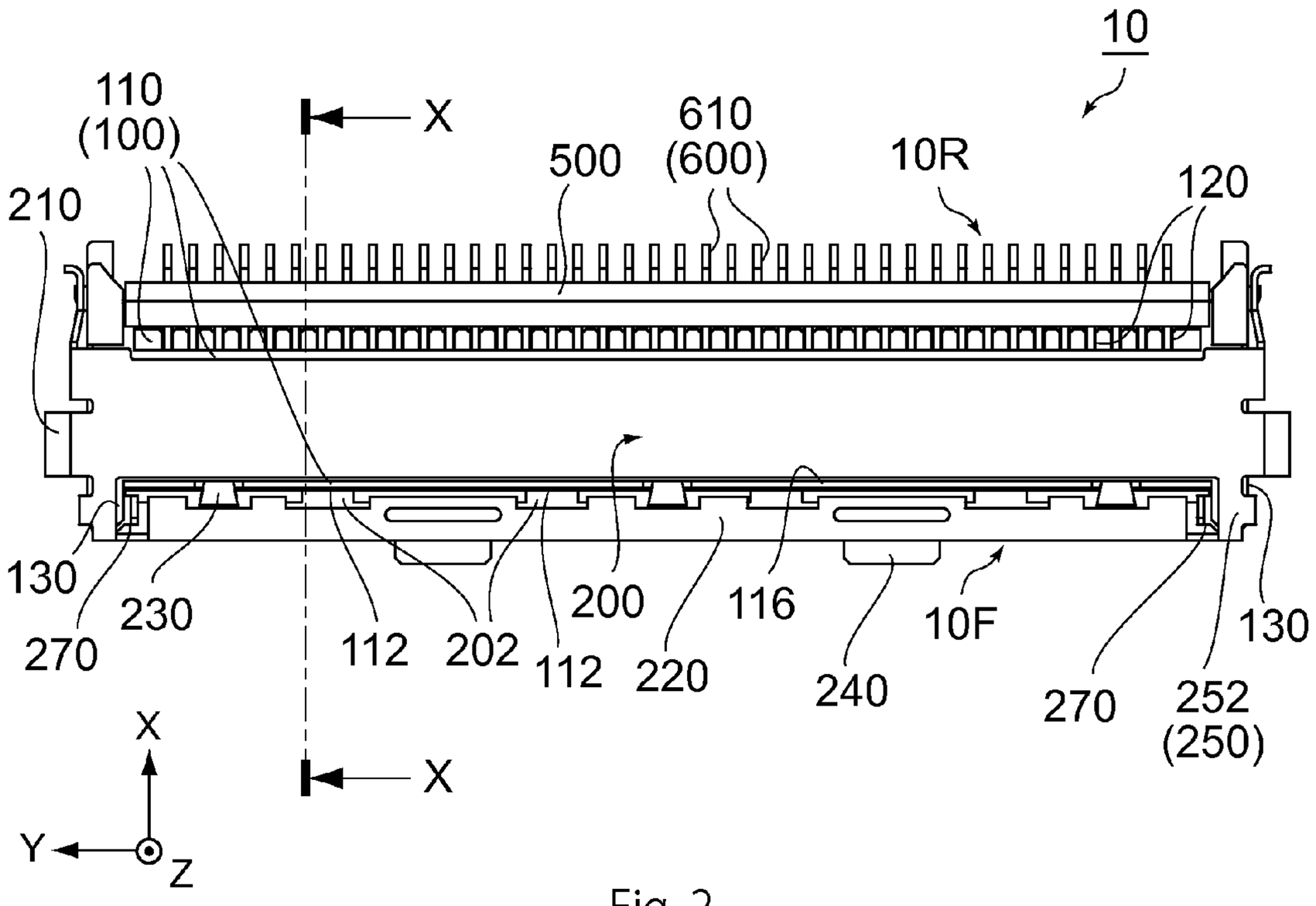
116
(110)
230
(200B)
12
252
(250)
210
Z
Y
X
116
(110)
220
(200B)
10F
256
(250)
254
(250)

Fig. 1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X
610
(600)
500
10R
120
210
130
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230
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202
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200
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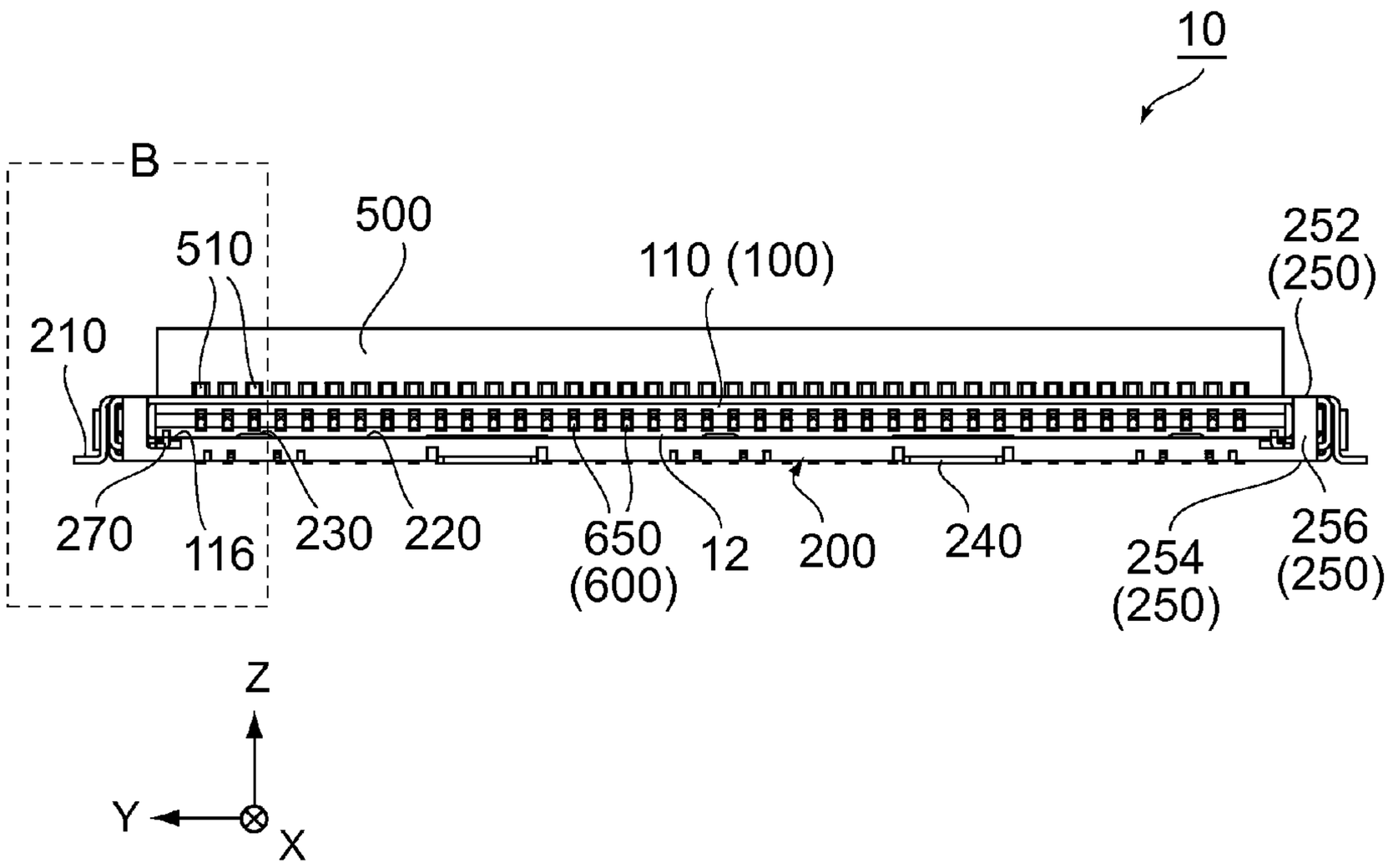
116
240
10F
270
252
(250)
130
X
X
Y
Z

Fig. 2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B
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110 (100)
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(250)
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12
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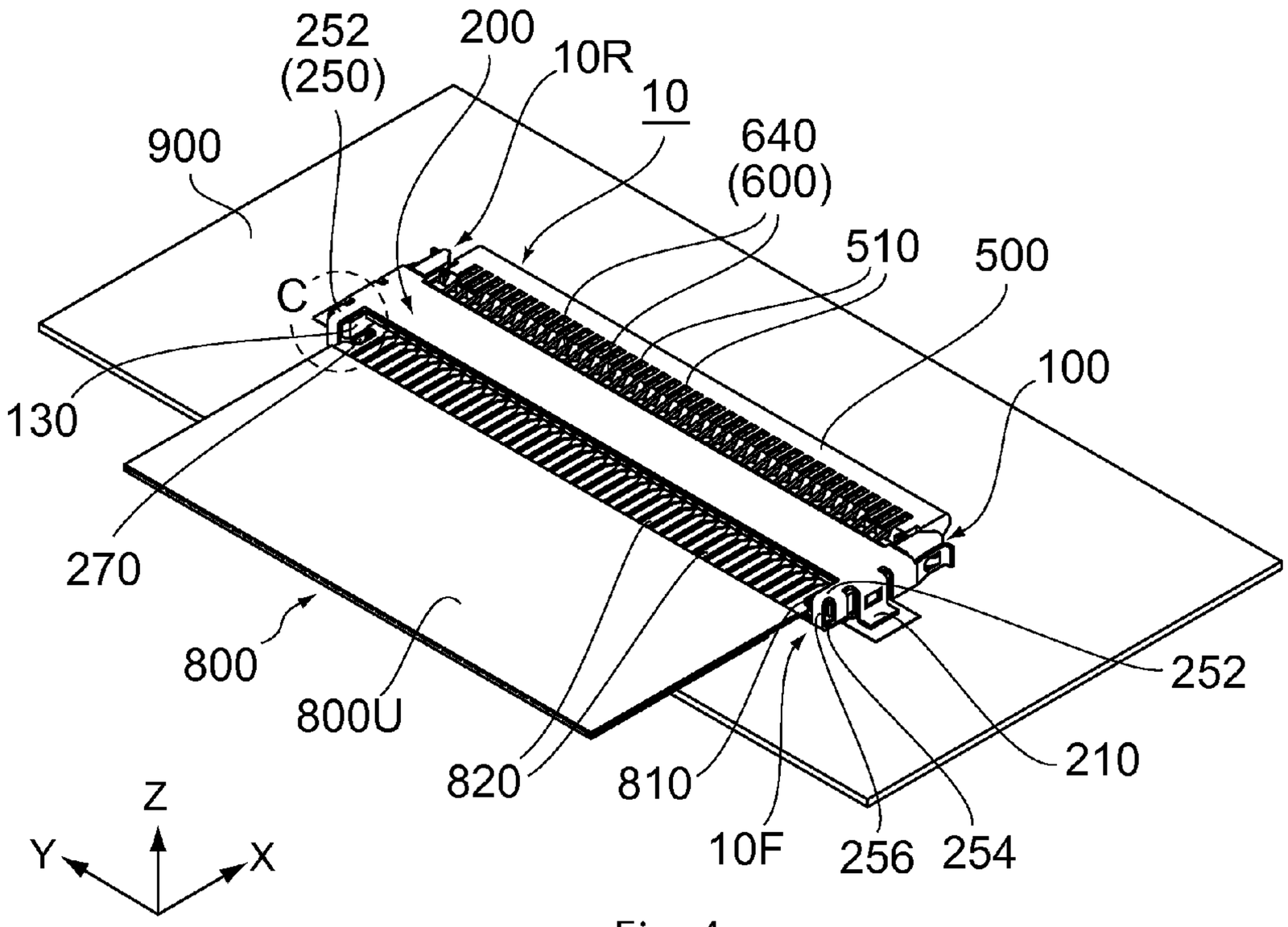
240
254
(250)
256
(250)
Z
Y
X

Fig. 3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900
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(600)
510
500
C
100
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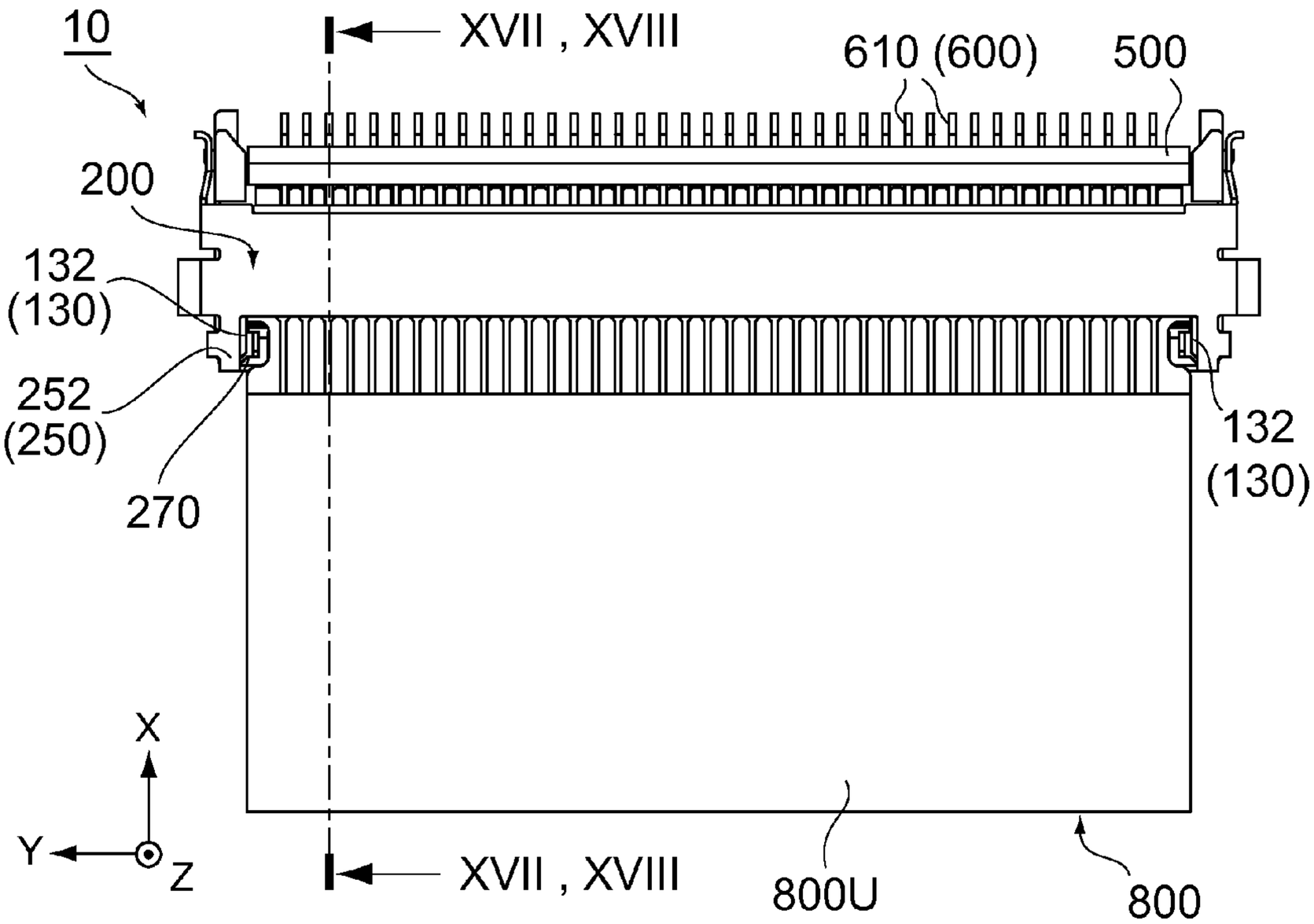
270
800
800U
820
810
252
210
10F
256
254
Z
Y
X

Fig. 4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XVII , XVIII
610 (600)
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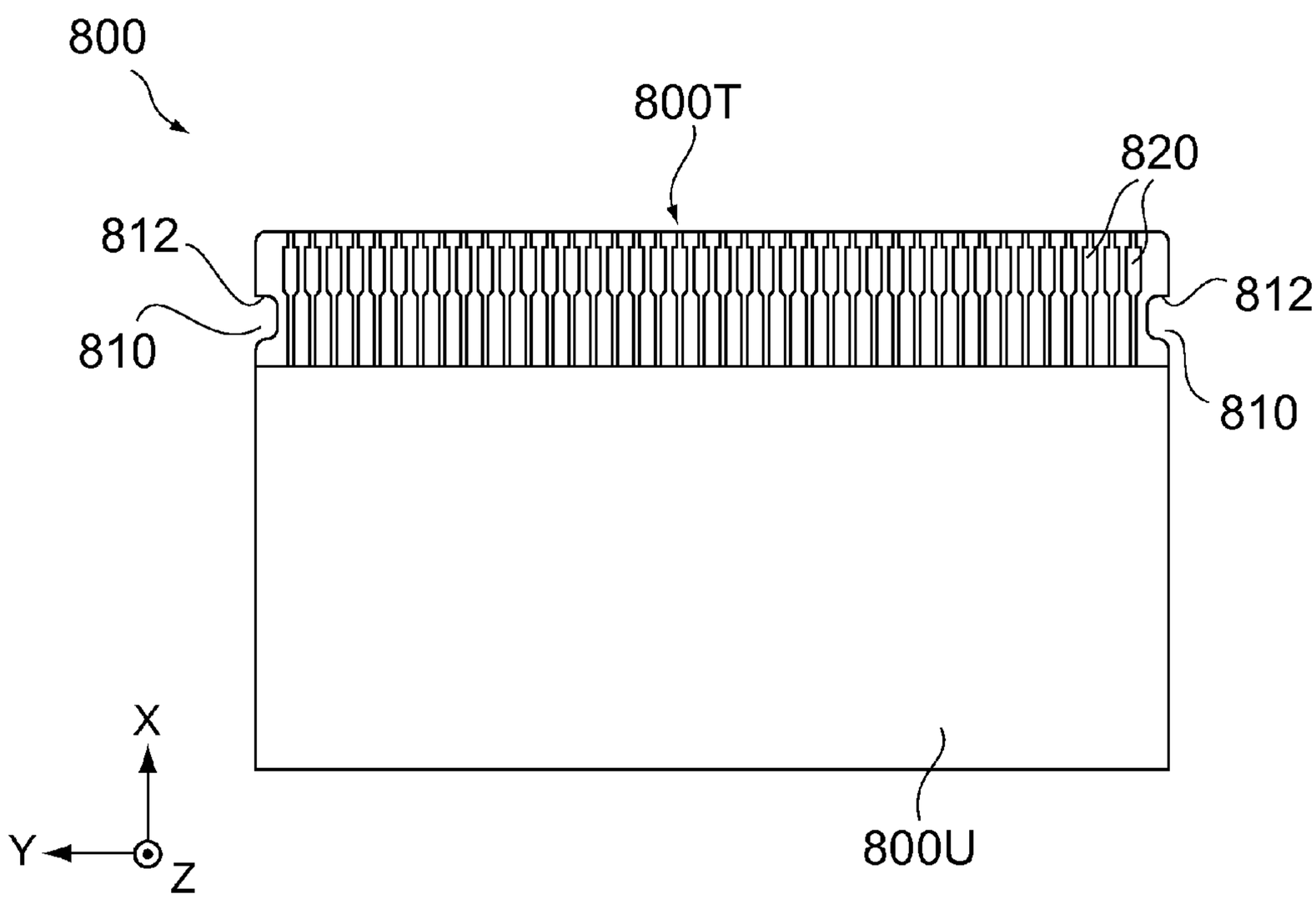
200
132
(130)
252
(250)
270
132
(130)
X
Y
Z
XVII , XVIII
800U
800

Fig. 5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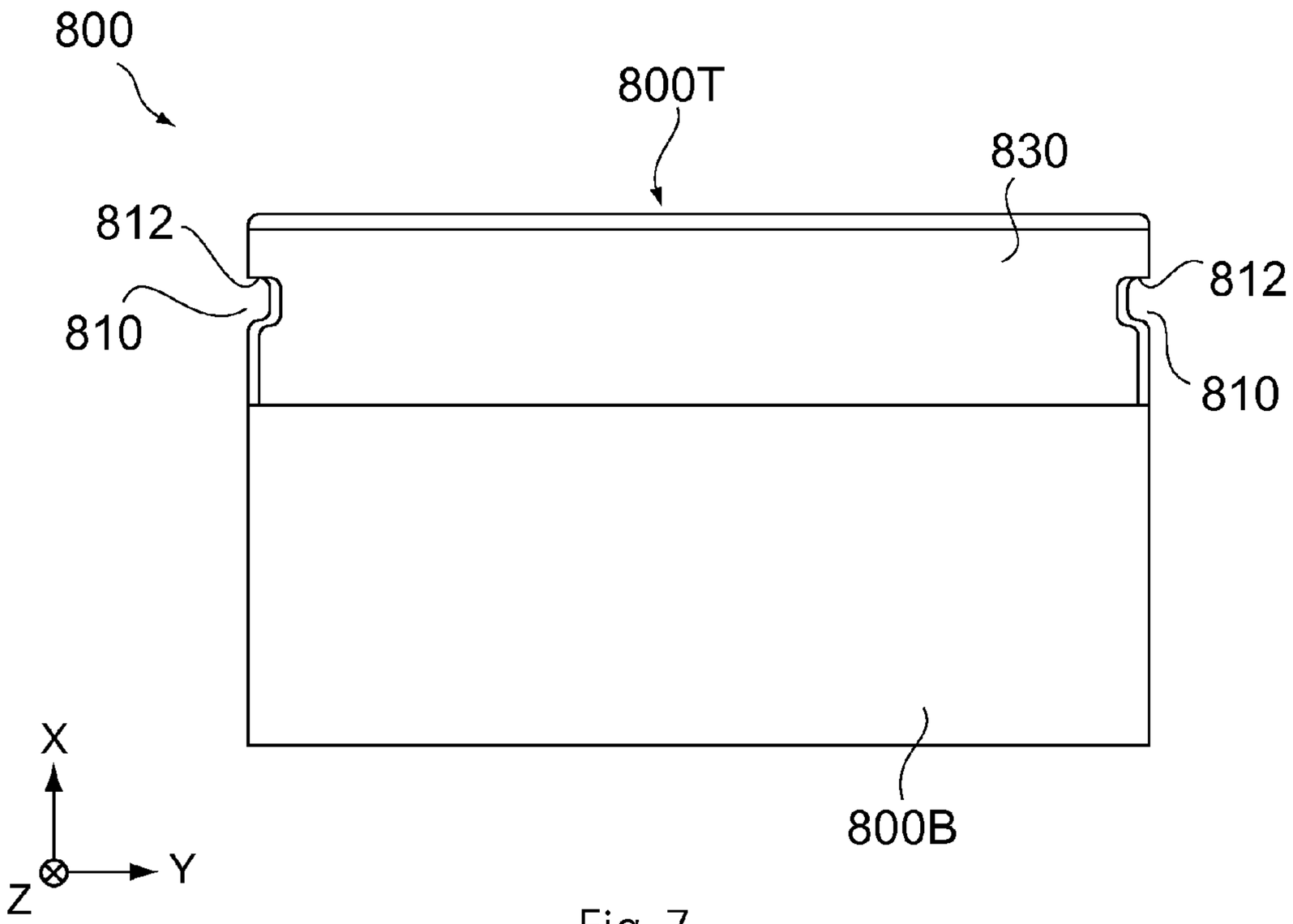
812
812
810
810
X
Y
Z
800U

Fig. 6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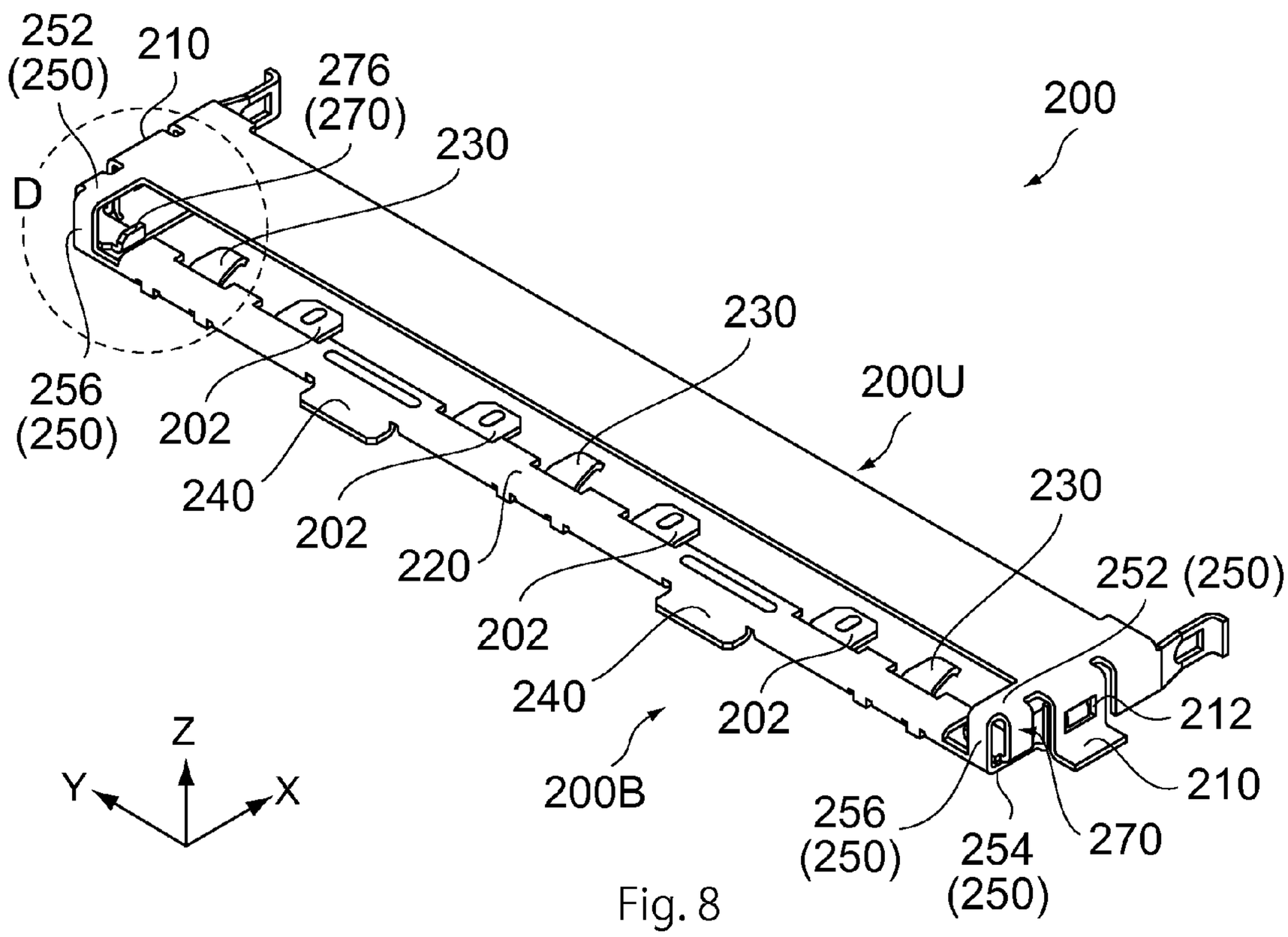
812
810
812
810
800B
X
Y
Z

Fig. 7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200U
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(250)
202
240
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220
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202
240
202
212
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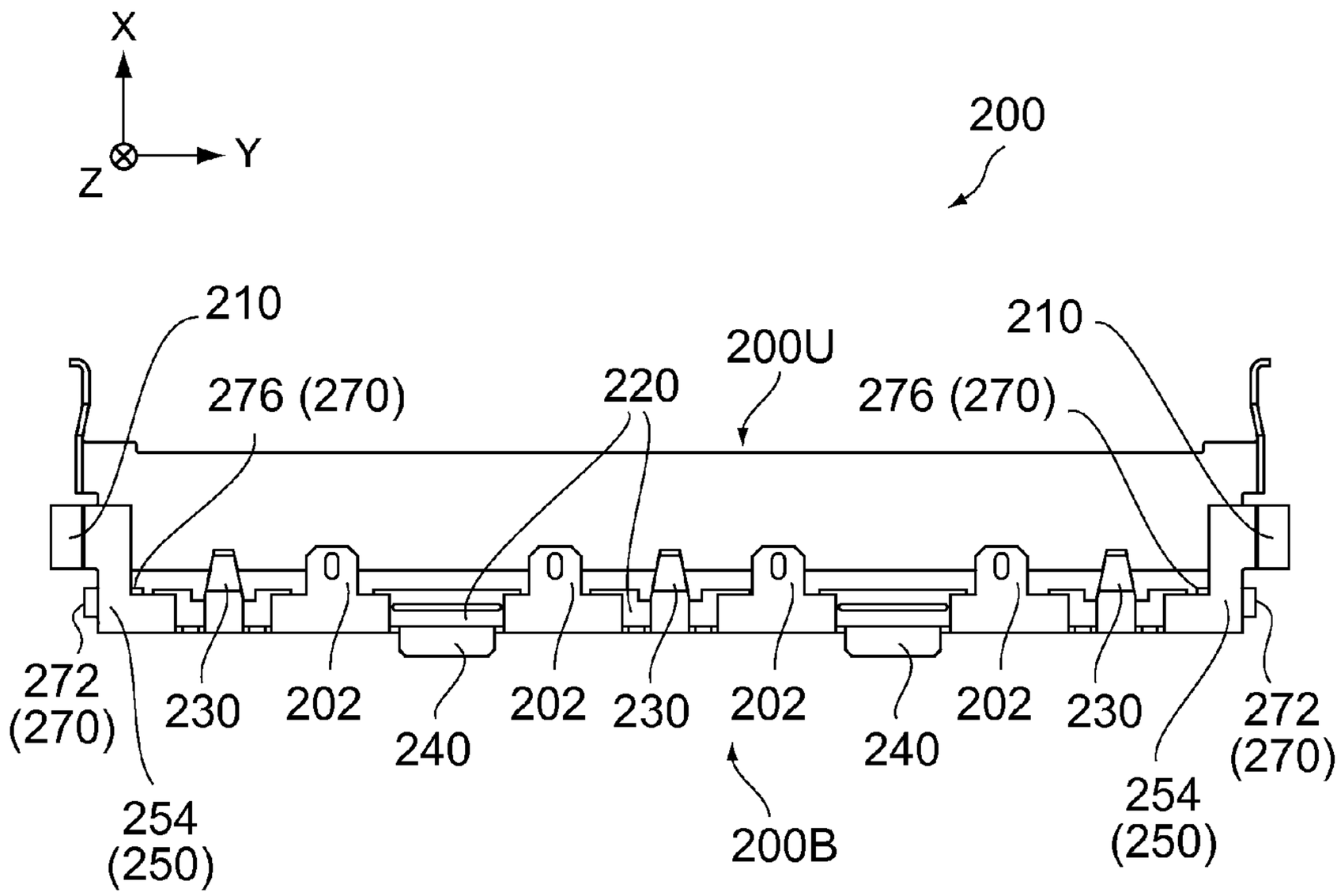
200B
256
(250)
254
(250)
270
Z
Y
X

Fig. 8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220
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276 (270)
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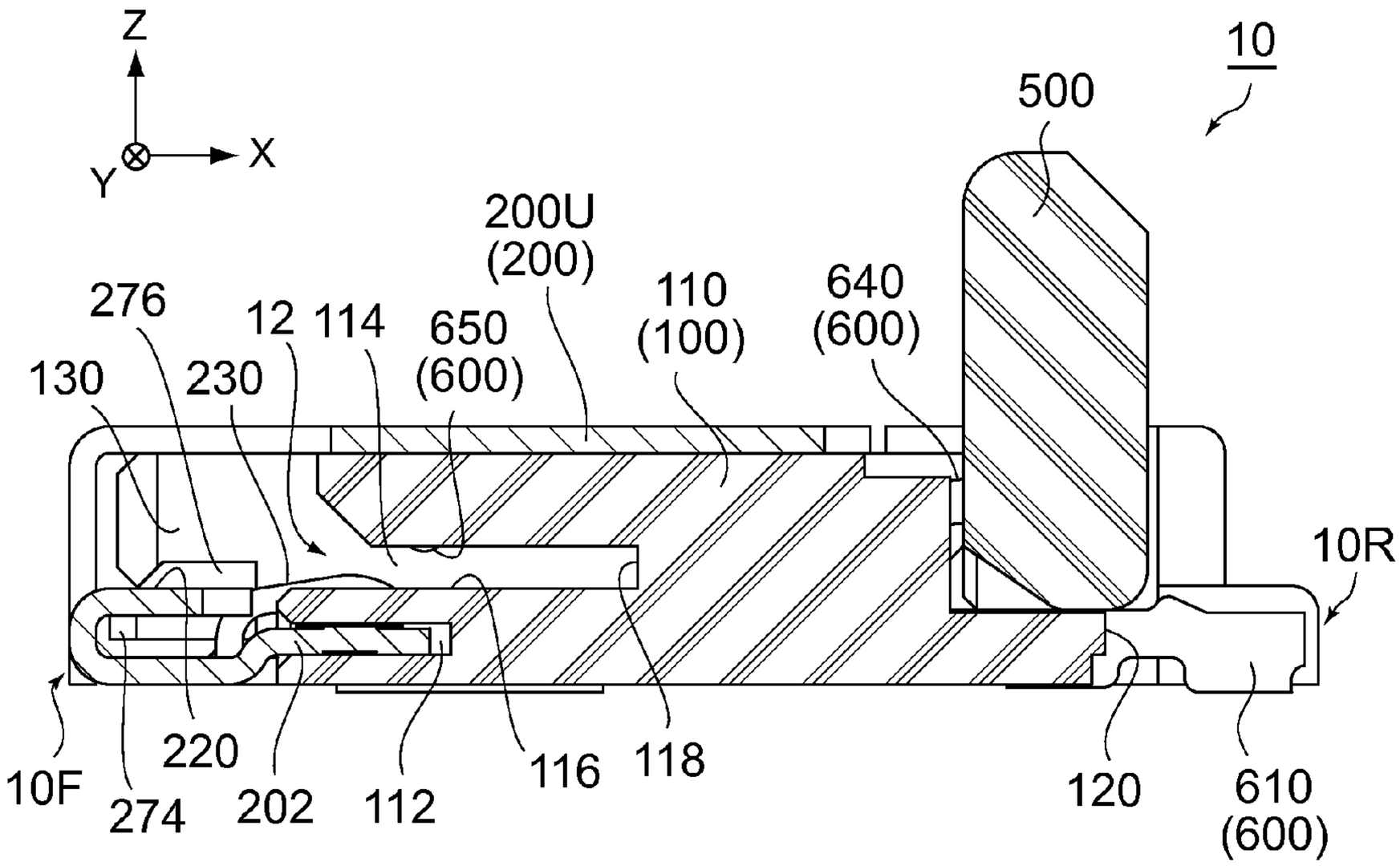
240
202
230
272 (270)
254 (250)
200B
254 (250)

Fig. 9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200U (200)
110 (100)
640 (600)
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276
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130
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112
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118
120
610 (600)

Fig. 10

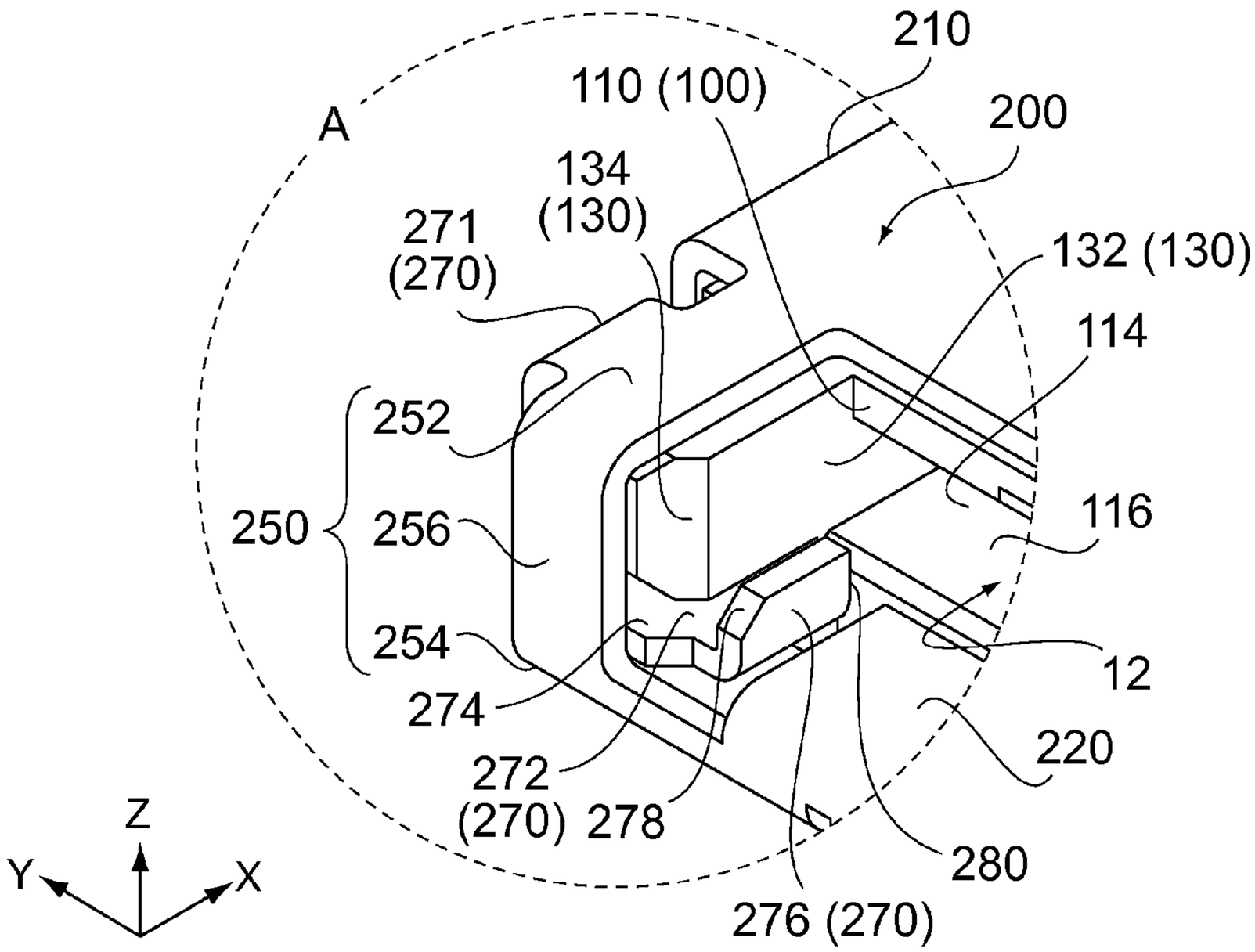
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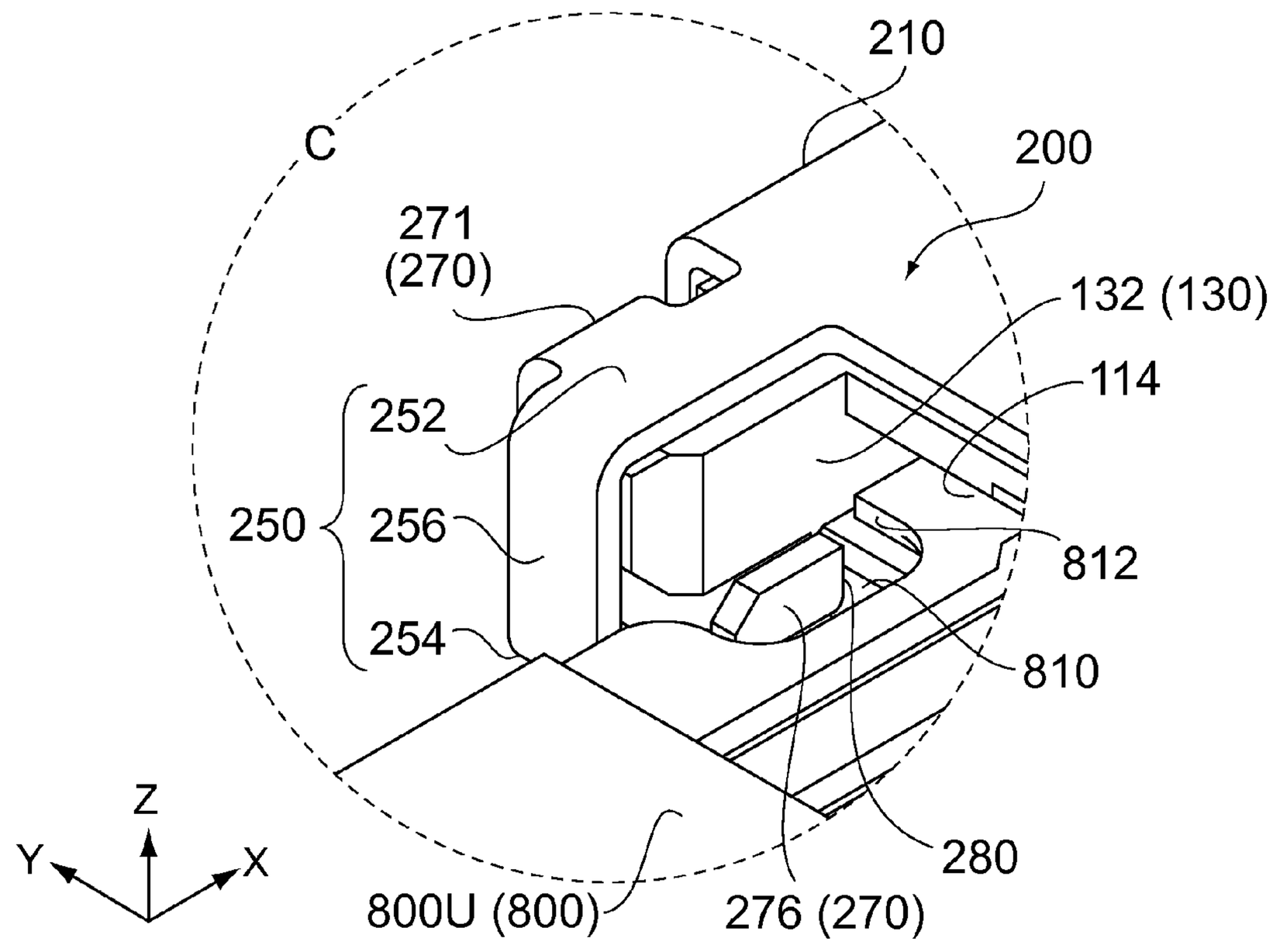
Fig. 11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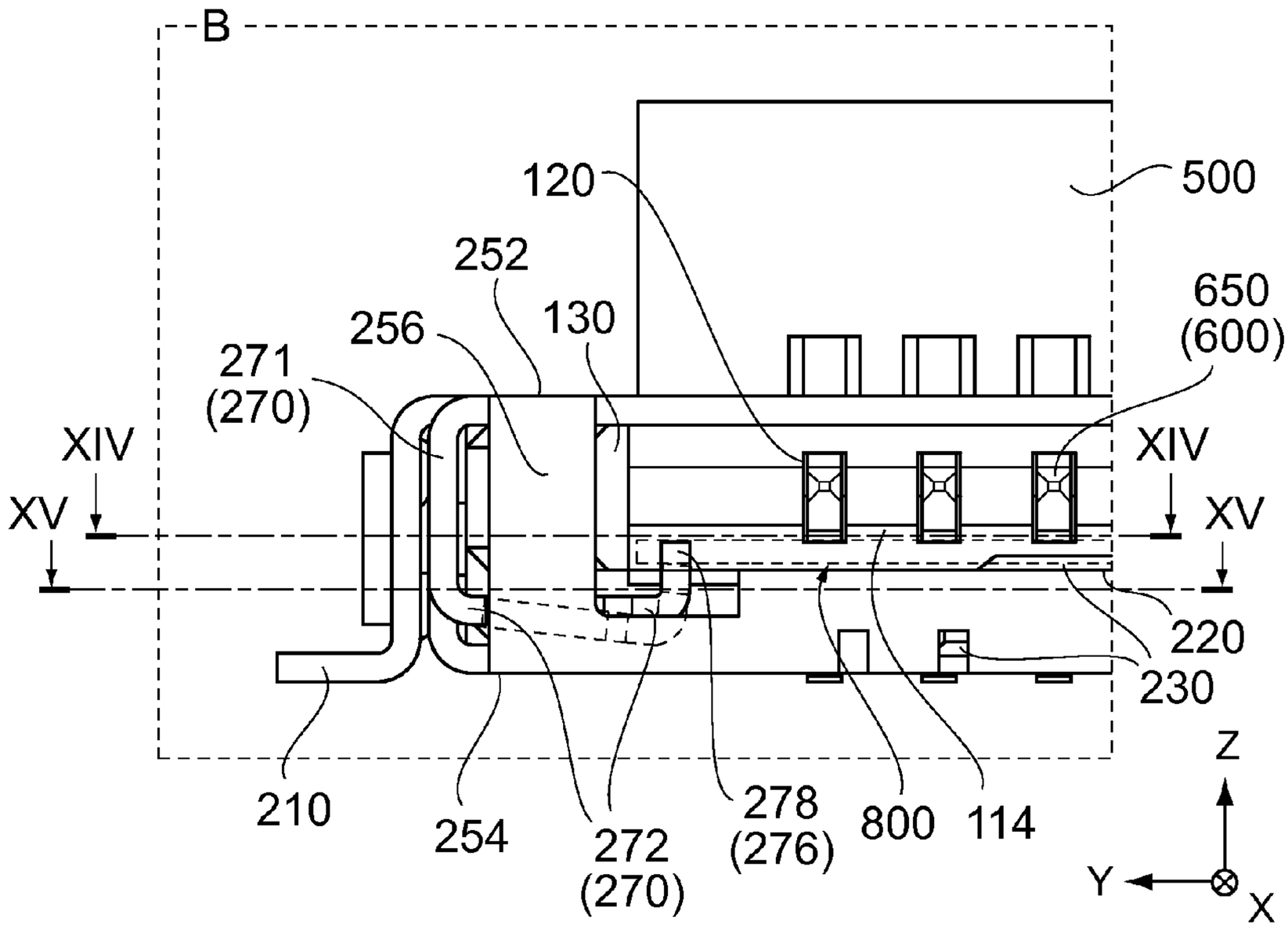
276 (270)
Z
Y
X

Fig. 12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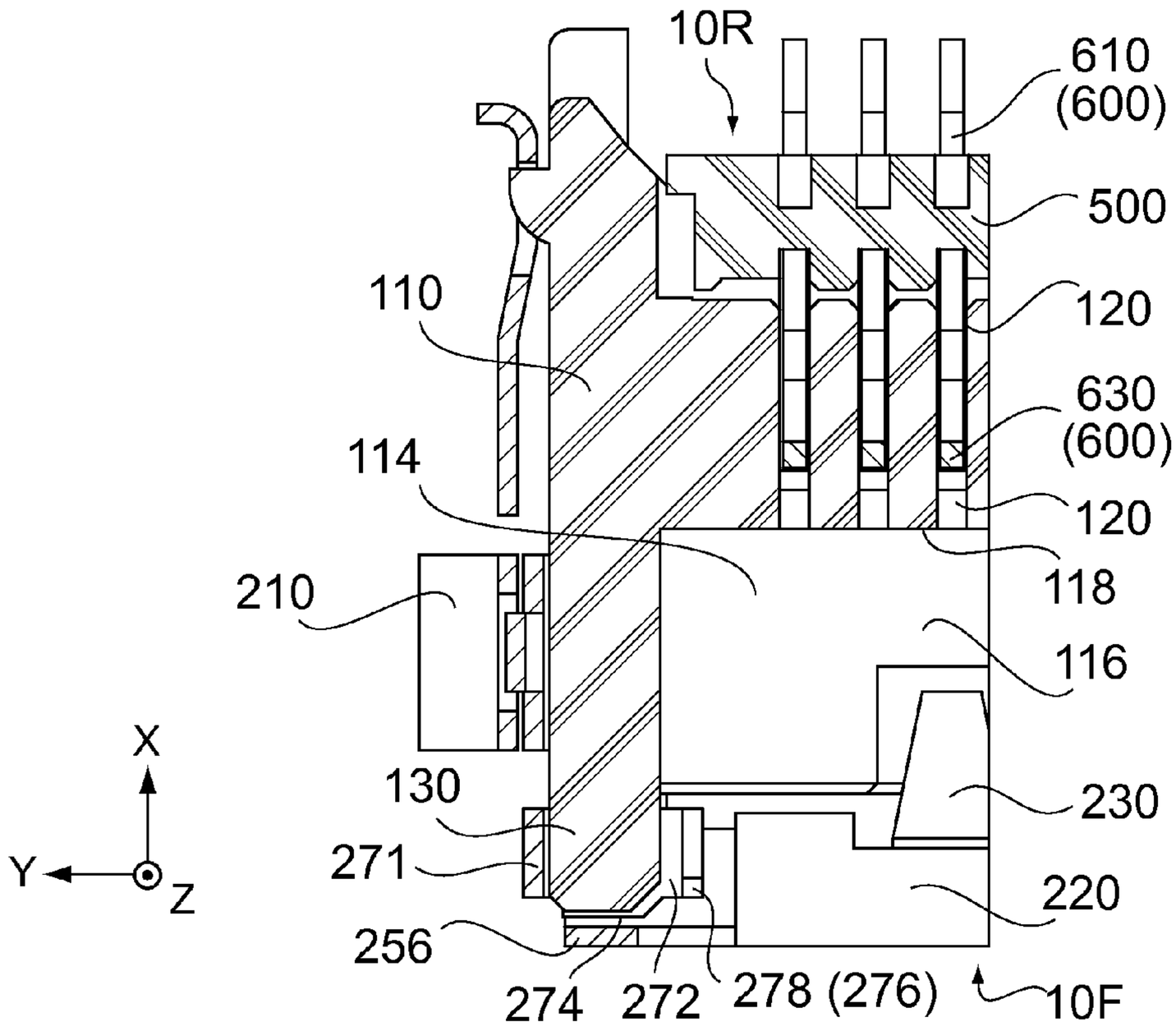
130
271
(270)
XIV
XV
XIV
XV
220
230
210
254
272
(270)
278
(276)
800
114
Z
Y
X

Fig. 13


10R
610
(600)
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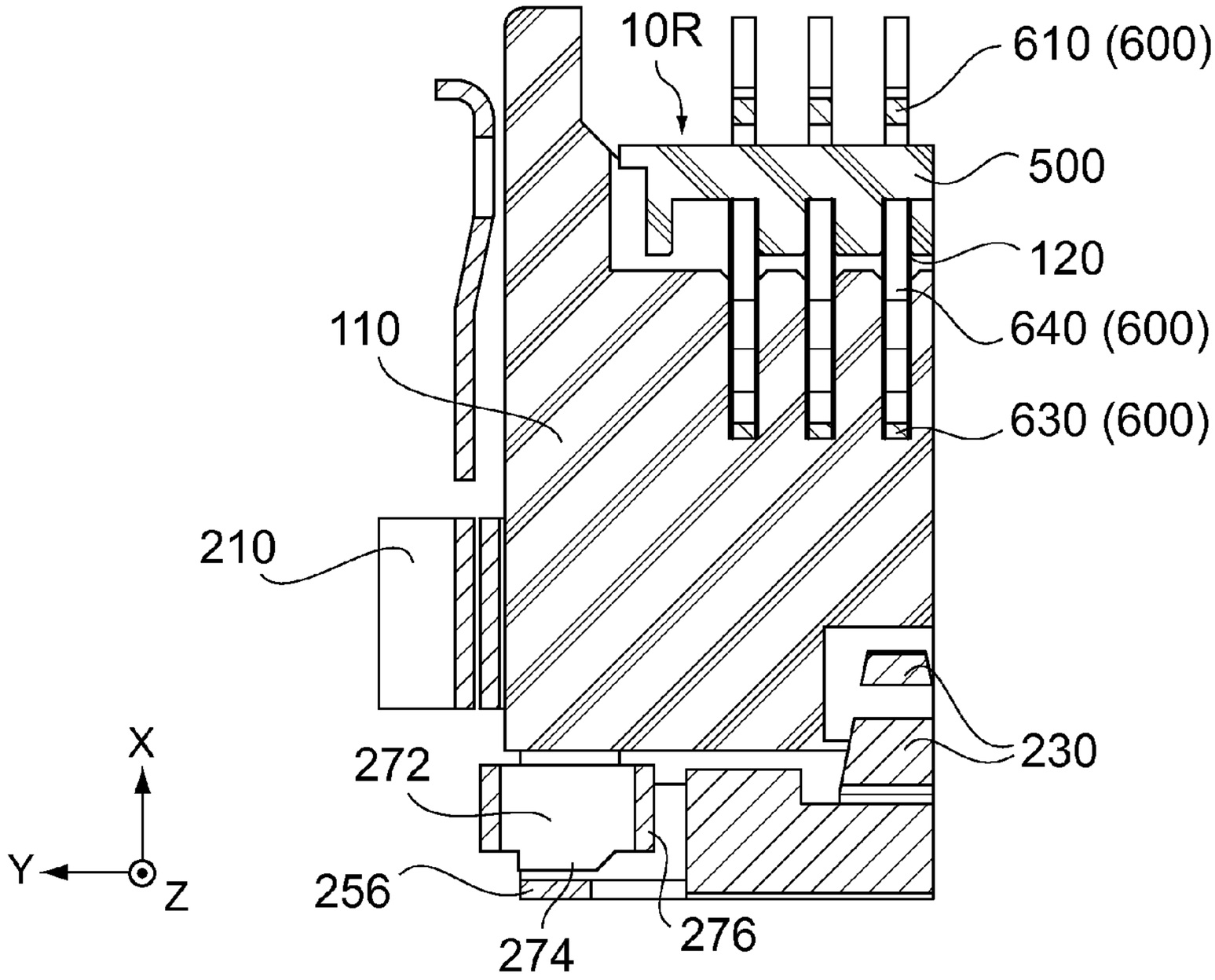
274
272
278 (276)
10F
X
Y
Z

Fig. 14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630 (600)
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274
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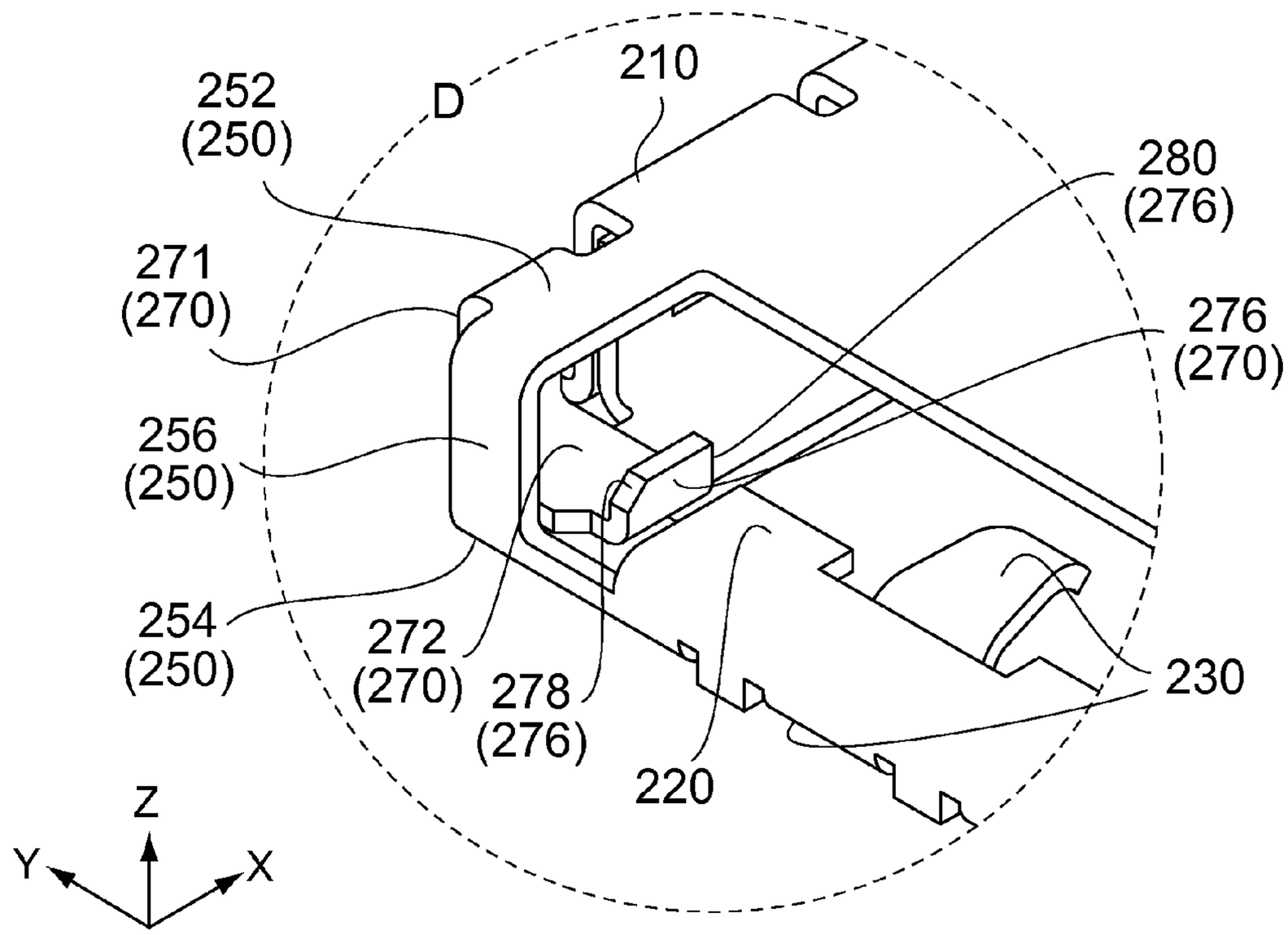
X
Y
Z

Fig. 15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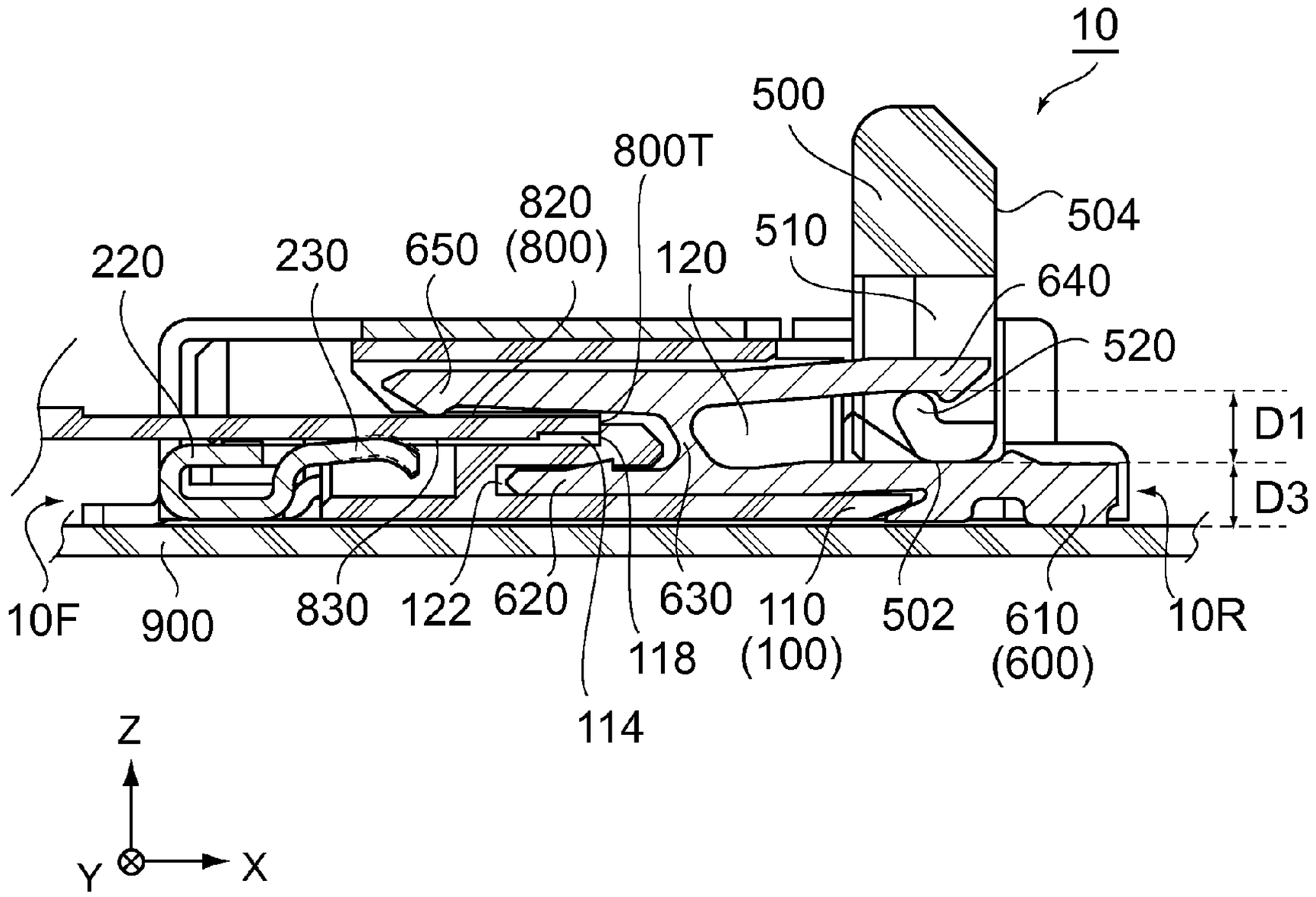
Z
Y
X

Fig. 16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640
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D1
D3
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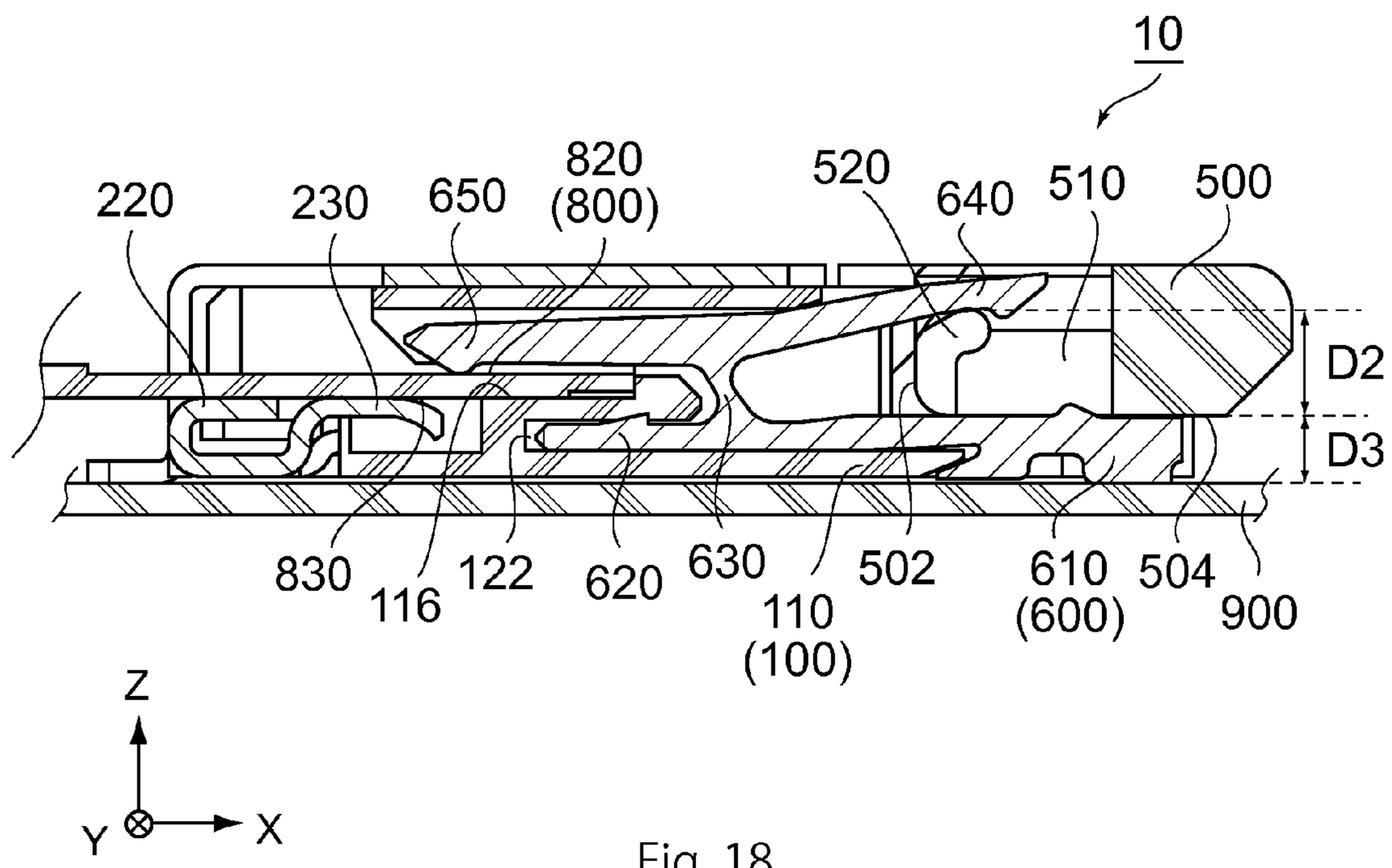
(100)
502
610
(600)
10R
118
114
Z
Y
X

Fig. 17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220
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(800)
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510
500
D2
D3
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122
620
630
110
(100)
502
610
(600)
504
900
Z
Y
X

Fig. 18

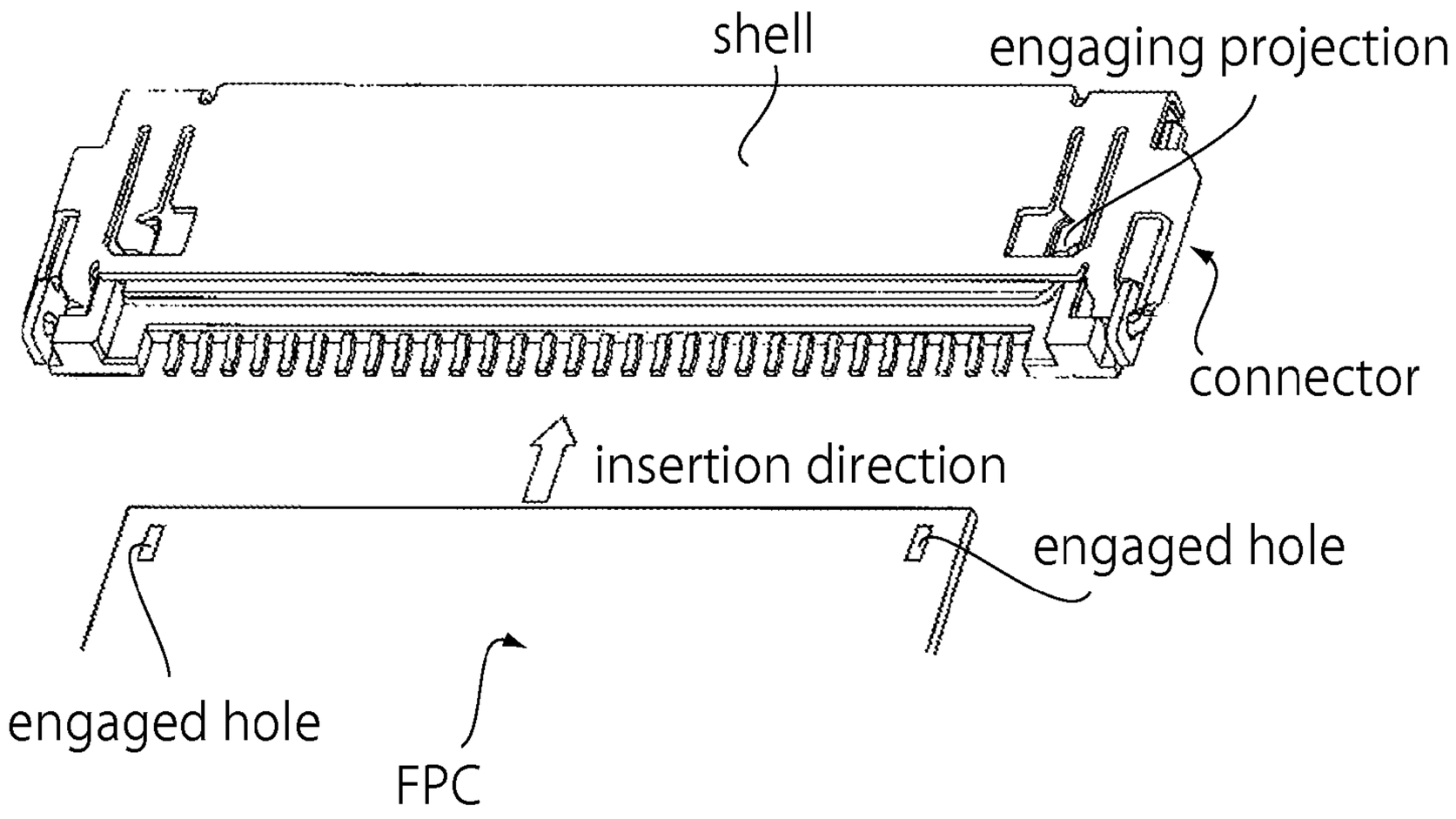
shell
engaging projection
connector
insertion direction
engaged hole
engaged hole
FPC

Fig. 19

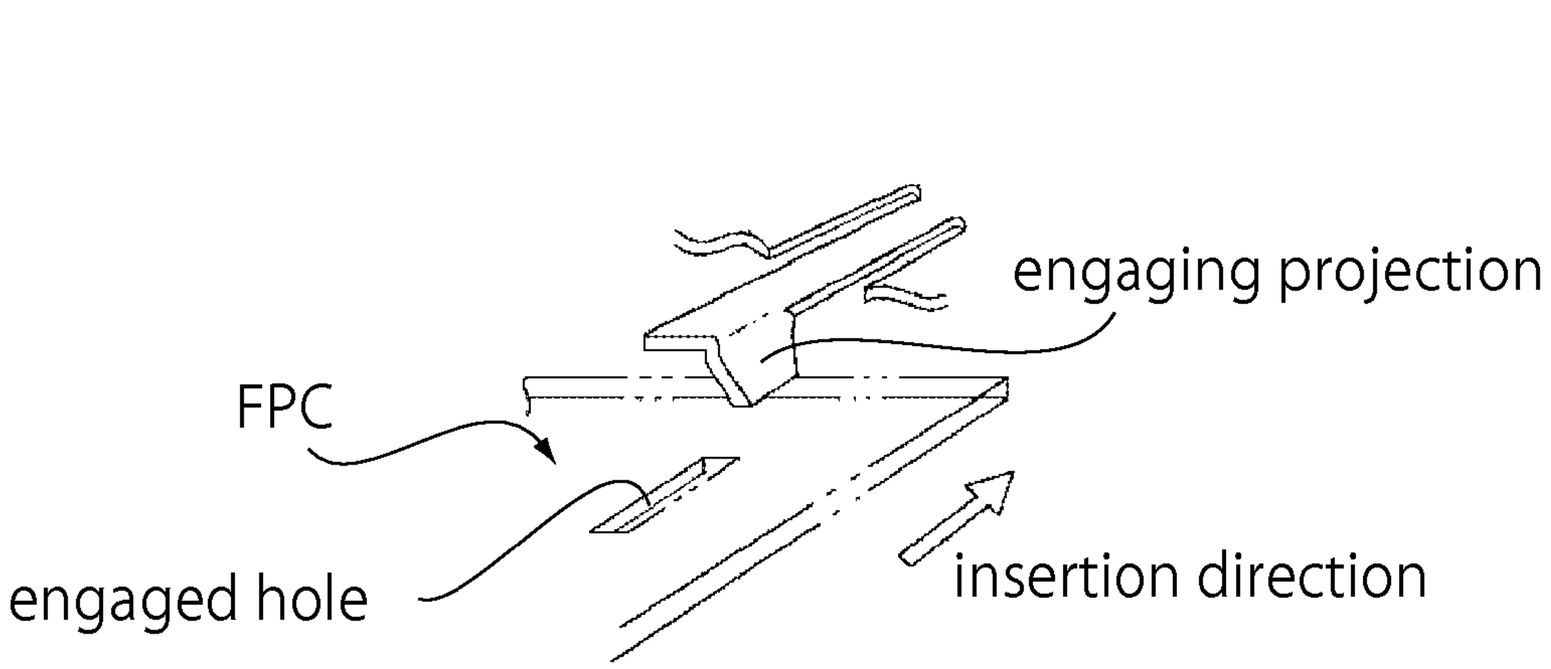
engaging projection
FPC
engaged hole
insertion direction

Fig. 20

CONNECTOR INCLUDING LOCKING STRUCTURE HAVING A LOCKING LUG AND A SPRING PORTION

CROSS REFERENCE TO RELATED APPLICATIONS

Applicants claim priority under 35 U.S.C. §119 of Japanese Patent Application No. JP2011-259404 filed Nov. 28, 2011.

BACKGROUND OF THE INVENTION

The present invention relates to a connector connectable with a connection object such as a FPC (Flexible Printed Circuits) and lockable a connection between the connector and the connection object.

A connector of this type is disclosed in JP-A 2008-192574, which is incorporated herein by reference in its entirety. As shown in FIG. **19** and FIG. **20**, a connector disclosed in JP-A 2008-192574 is connectable with an FPC (a connection object) which has an engaged hole. The FPC is inserted into and connected with the connector from the front of the connector in an insertion direction. The connector comprises a shell which has an engaging projection (a lock portion). In a connection state where the FPC and the connector are connected with each other, the engaging projection is positioned in the engaged hole so that the connection state between the FPC and the connector is locked. In detail, when the FPC in the connection state is pulled in a eject direction opposite to the insertion direction, the engaging projection engages with the engaged hole and, therefore, the connection state between the FPC and the connector is maintained.

According to the connector of JP-A 2008-192574, when the FPC connected with the connector is pulled by force, at least the engaged hole or the engaging projection may be damaged. When the engaged hole or the engaging projection is damaged, the connection between the FPC and the connector may be released (unlocked) so that FPC may be pulled out of the connector.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a connector having a structure which can lock the connection with the FPC securely.

One aspect of the present invention provides a connector connectable with a connection object having a locked portion, the connection object being inserted into the connector from the front of the connector in an insertion direction. The connector comprises: a housing; an attachment attached to the housing and comprising an upper attachment positioned higher than the housing, a lower attachment positioned lower than the housing, and a coupling portion coupling the upper attachment and the lower attachment; and a lock portion comprising a locking lug positioned rearward of the coupling portion and engaging with the locked portion of the connection object when the connection object connected with the connector is moved in an eject direction opposite to the insertion direction, and a spring portion positioned between the upper attachment and the lower attachment and supporting the locking lug so as to be displaceable in a vertical direction perpendicular to the insertion direction.

An appreciation of the objectives of the present invention and a more complete understanding of its structure may be had by studying the following description of the preferred embodiment and by referring to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an oblique view showing a connector according to the embodiment of the present invention. An actuator of the connector is positioned at an open position.

FIG. **2** is a plan view showing the connector of FIG. **1**.

FIG. **3** is a front view showing the connector of FIG. **1**.

FIG. **4** is an oblique view showing the connector of FIG. **1**. An FPC (a connection object) is inserted to and connected with the connector. The actuator is positioned at a close position.

FIG. **5** is a plan view showing the connector of FIG. **1**. The FPC is inserted to the connector. An actuator is positioned at an open position.

FIG. **6** is a plan view showing the FPC to be inserted to and connected with the connector of the embodiment.

FIG. **7** is a bottom view showing the FPC of FIG. **6**.

FIG. **8** is an oblique view showing a shell of the connector of FIG. **1**.

FIG. **9** is a bottom view showing the shell of FIG. **8**.

FIG. **10** is a cross-sectional view showing the connector of FIG. **2**, taking along line X-X.

FIG. **11** is an enlarged partial oblique view showing an attachment and a lock portion (i.e. an area "A" enclosed with a dashed line in FIG. **1**) of the connector of FIG. **1**.

FIG. **12** is an enlarged partial oblique view showing the attachment and the lock portion (i.e. an area "C" enclosed with a dashed line in FIG. **4**) of the connector of FIG. **4**.

FIG. **13** is an enlarged partial oblique view showing the attachment and the lock portion (i.e. an area "B" enclosed with a dashed line in FIG. **3**) of the connector of FIG. **3**. The FPC and the lock portion are illustrated with dashed lines. The lock portion is displaced downward by the inserted FPC.

FIG. **14** is a cross-sectional view partially showing the attachment and the lock portion of FIG. **13** taking along line XIV-XIV.

FIG. **15** is a cross-sectional view partially showing the attachment and the lock portion of FIG. **13** taking along line XV-XV.

FIG. **16** is an enlarged partial oblique view showing the attachment and the lock portion (i.e. an area "D" enclosed with a dashed line in FIG. **8**) of the connector of FIG. **8**.

FIG. **17** is a cross-sectional view showing the connector of FIG. **5**, taking along XVII-XVII. A ground spring portion before being displaced downward is illustrated with a dashed line.

FIG. **18** is a cross-sectional view showing the connector of FIG. **5**, taking along XVIII-XVIII. The actuator is rotated from the open position to the close position. The FPC is connected with connector.

FIG. **19** is an oblique view showing an example of a conventional connector and an FPC inserted to the conventional connector.

FIG. **20** is an enlarged partial oblique view showing a engaging projection of the conventional connector of FIG. **19**.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof are shown by way of example in the drawings and will herein be described in detail. It should be understood, however, that the drawings and detailed description thereto are not intended to limit the invention to the particular form disclosed, but on the contrary, the intention is to cover all modifications, equiva-

lents and alternatives falling within the spirit and scope of the present invention as defined by the appended claims.

DESCRIPTION OF PREFERRED EMBODIMENTS

As shown in FIG. **1** and FIG. **4**, a connector **10** of the embodiment is configured to be mounted and fixed to a mount object (for example, a circuit board **900**). The connector **10** is connectable with an FPC (a connection object) **800** in a state where the connector **10** is mounted on the circuit board **900**.

The connector **10** is a low-profile connector which has a thin plate like shape in the vertical direction (in a Z direction) and extends in a width direction (in a Y direction) perpendicular to the vertical direction. The connector **10** has a front end **10**F and a rear end **10**R in an insertion direction and an eject direction (in a X direction), wherein the front end **10**F is an end portion in a −X direction while the rear end **10**R is an end portion in a +X direction.

As understood from FIG. **1**, FIG. **3** and FIG. **4**, the connector **10** comprises an insertion opening **12**. The insertion opening **12** is positioned at the front end **10**F of the connector **10** and extends in the Y direction. The FPC **800** is inserted into the insertion opening **12** in the insertion direction (in the +X direction) and is connected with the connector **10**. The FPC **800** connected with the connector **10** is ejected from the connector **10** in the eject direction (in the −X direction).

As shown in FIG. **6** and FIG. **7**, the FPC **800** has a rectangular sheet like shape and is brought in parallel with an XY surface before being inserted to the insertion opening **12**. The FPC **800** has a top end **800**T positioned at the end of the FPC **800** in the +X direction, an upper surface (a signal surface) **800**U positioned at the upper side of the FPC **800** in the +Z direction, and a bottom surface **800**B (a ground surface) positioned at the bottom side of the FPC **800** in the −Z direction. The top end **800**T extends in the Y direction.

The FPC **800** comprises a plurality of signal contacts **820** and a ground contact **830**. The signal contacts **820** are arranged in the Y direction so that spaces between each of the neighboring signal contacts **820** are the same and that the signal contacts **820** are exposed at the upper surface **800**U in the vicinity of the top end **800**T. The ground contact **830** extends in the Y direction and is exposed at the bottom surface **800**B in the vicinity of the top end **800**T.

As shown in FIG. **6**, FIG. **7** and FIG. **12**, the FPC **800** comprises two locked portions **810**. The locked portions **810** are formed on both sides of the FPC **800** in the Y direction. Each of the locked portions **810** is recessed inward of the FPC **800** in the Y direction. However, the shapes of the locked portions **810** are not limited thereto. The locked portions **810** may project outward of the FPC **800**. The locked portions **810** may be holes formed on the FPC **800**. The locked portions **810** are formed with engaged portions **812**. Each of the engaged portions **812** has a surface perpendicular to the X direction.

As shown in FIG. **1** to FIG. **3**, the connector **10** comprises a housing **100** made of insulative material, a shell **200** made of metal, an actuator **500** made of insulative material, and a plurality of contacts **600**.

As shown in FIG. **1**, FIG. **2**, and FIG. **10** to FIG. **12**, the housing **100** comprises a body portion **110**. The body portion **110** has a thin plate like shape in the Z direction and extends in the Y direction. The housing **100** comprises two arms **130** which guide the FPC **800** when the FPC **800** is inserted to the connector **10**. The arms **130** are formed on both sides of the body portion **110** in the Y direction.

As shown in FIG. **10** to FIG. **12**, the arms **130** extend forward (i.e. in the −X direction) from the body portion **110**. Each of the arms **130** has an inner side and an outer side in the Y direction. The inner side of the arm **130** is formed with a guide surface **132** in parallel with an XZ surface. A distance between the guide surfaces **132** in the Y direction is substantially equal to a width of the FPC **800** (see FIG. **5**). Each of the arms **130** further comprises an oblique surface **134** oblique to the X direction and the Y direction. The oblique surface **134** is positioned on the front of the guide surface **132**. In detail, the oblique surface **134** extends forward and outward in the Y direction from the guide surface **132** so that the oblique surface **134** can guide the FPC **800** to the insertion opening **12**.

As understood from FIG. **10** to FIG. **13**, the body portion **110** of the housing **100** has an inserted portion (a receiving space) **114** into which the FPC **800** is inserted. The inserted portion **114** is a recess portion recessed rearward and extends between the guide surfaces **132** in the Y direction. The inserted portion **114** communicates with the insertion opening **12** in the −X direction and extends toward the center of the body portion **110** in the +X direction.

As show in FIG. **10** to FIG. **12**, the body portion **110** further comprises a bottom portion **116** and an abutment portion **118**. The bottom portion **116** of the embodiment has a surface in parallel with the XY surface. The bottom portion **116** defines the bottom of the inserted portion **114**. The inserted and connected FPC **800** is arranged on the bottom portion **116**. The abutment portion **118** has a surface perpendicular to the X direction and is formed at the rear end portion of the inserted portion **114** (i.e. at the rear end portion of the bottom portion **116**).

As understood from FIG. **2**, FIG. **10**, FIG. **14** and FIG. **17**, the body portion **110** of the housing **100** is formed with a plurality of contact accommodation portions **120** and a plurality of holding portions **122**. The contacts **600** correspond to the contact accommodation portions **120** and the holding portions **122**.

As understood from FIG. **13**, FIG. **14** and FIG. **17**, the contact accommodation portion **120** extends in the body portion **110** in the X direction. In detail, a rear part of the contact accommodation portion **120** opens at the rear end **10**R of the connector **10** while the front portion of the contact accommodation portion **120** opens at the front end **10**F of the connector **10**. The front part of the contact accommodation portion **120** communicates with the inserted portion **114**.

As shown in FIG. **17**, the holding portion **122** is a recess (a hole) extending in the body portion **110** in the X direction. The holding portion **122** communicates with a bottom part of the contact accommodation portion **120** in the X direction. The contact **600** is inserted from the rear end **10**R of the connector **10** and accommodated in the contact accommodation portion **120** and the holding portion **122** so that the contact **600** is fixed to the housing **100**.

As shown in FIG. **17**, the contact **600** of the embodiment comprises a fixed portion **610**, the held portion **620**, a connection portion **630**, a supported portion **640**, and a contact portion **650**. The connection portion **630** is positioned at the center of the contact **600** in the X direction. In detail, the connection portion **630** connects an upper part of the contact **600** with a lower part of the contact **600** in the Z direction, wherein the lower part consists of the fixed portion **610** and held portion **620**, and the upper part consists of the supported portion **640** and the contact portion **650**.

The fixed portion **610** is fixed to the circuit board **900** by soldering or the like. The held portion **620** is press-fitted into the holding portion **122** so that the contact **600** is held by the housing **100**. The contact portion **650** extends forward (in the

−X direction) from the connection portion **630**. The supported portion **640** extends rearward (in the +X direction) from the connection portion **630**. The supported portion **640** and the contact portion **650** are supported by the connection portion **630** so as to be displaceable in the Z direction. When the supported portion **640** is displaced upward (in the +Z direction), the contact portion **650** is displaced downward (in the −Z direction).

As shown in FIG. **10**, FIG. **13** and FIG. **17**, the contact portion **650** extends through the contact accommodation portion **120** and above the inserted portion **114**. When seen along the +X direction, the front end of the contact portion **650** is visible. A part of the front end of the contact portion **650** (in detail, the lower end of the front end) project into the inserted portion **114**.

As understood from FIG. **1** to FIG. **4**, the actuator **500** has a plate-like shape extending in the Y direction. The actuator **500** is attached to the housing **100** from the rear end **10**R of the connector **10** and is supported by the housing **100** so that the actuator **500** is rotatable between an open position (FIG. **17**) and a close position (FIG. **18**). The actuator **500** is formed with a plurality of supporting holes **510** penetrating the actuator **500**. The supporting holes **510** correspond to the contacts **600**.

As shown FIG. **17** and FIG. **18**, a support portion **520** is formed in the supporting hole **510**. The supported portion **640** of the contact **600** extends in the supporting hole **510** and is supported by the support portion **520** so as to be displaceable in the Z direction. In other words, supported portion **640** is always brought into contact with the upper end (i.e. the end portion in the +Z direction) of the support portion **520**.

The actuator **500** has a first reference surface **502** and a second reference surface **504**. The first reference surface **502** is a bottom surface of the actuator **500** positioned at the open position. The second reference surface **504** is a bottom surface of the actuator **500** positioned at the close position. As shown in FIG. **17** and FIG. **18**, a distance D**3** (in FIG. **17**) between the first reference surface **502** and the circuit board **900** is equal to another distance D**3** (in FIG. **18**) between the second reference surface **504** and the circuit board **900**. On the other hand, a distance D**1** (in FIG. **17**) between the upper portion of the support portion **520** and the first reference surface **502** when the actuator **500** is positioned at the open position is shorter than another distance D**2** (in FIG. **18**) between the upper portion of the support portion **520** and the second reference surface **504** when the actuator **500** is positioned at the close position. In other words, a distance D**3**+D**1** (in FIG. **17**) between the upper portion of the support portion **520** and the circuit board **900** when the actuator **500** is positioned at the open position is shorter than another distance D**3**+D**2** (in FIG. **18**) between the upper portion of the support portion **520** and the circuit board **900**.

As understood from FIG. **1**, FIG. **2**, FIG. **8** and FIG. **9**, the shell **200** is attached to the housing **100** so as to partially cover the housing **100**. The shell **200** has an upper shell **200**U and a bottom shell **200**B. The upper shell **200**U covers the upper surface (a surface in the +Z direction) of the housing **100**. The bottom shell **200**B is positioned under the connector **10**.

As understood from FIG. **8** and FIG. **9**, the shell **200** of the embodiment is formed by cutting (stamping) and bending a metal sheet so that the shell **200** has the bottom shell **200**B and the upper shell **200**U having a plate-like shape. In detail, the shell **200** has a bent portion in the −X direction so that the upper shell **200**U is higher than the bottom shell **200**B in the Z direction and that the bottom shell **200**B is positioned forward (in the −X direction) from the upper shell **200**U. In other words, when seen along the +Y direction, the upper shell **200**U, the bent portion, the bottom shell **200**B constitute a rectangular C-like shape. The bottom shell **200**B has an upper portion and a bottom portion facing the upper portion. Each of the upper portion and the bottom portion is perpendicular to the Z direction.

As shown in FIG. **8** and FIG. **9**, the shell **200** of the embodiment has four press-fit portions **202** formed on the bottom portion of the bottom shell **200**B. Each of the press-fit portions **202** is in parallel with the XY surface and extends rearward (in the +X direction) from the bottom portion of the bottom shell **200**B.

As understood from FIG. **1**, FIG. **2** and FIG. **10**, the housing **100** is provided with four press-fitted portions **112** corresponding to the press-fit portions **202** of the shell **200**. The press-fitted portion **112** of the embodiment is a hole formed on the housing **100**. Each of the press-fitted portion **112** opens forward (in the −X direction) and extends rearward (in the +X direction) in parallel with the XY surface. The shell **200** is attached to the housing **100** from the front of the housing **100** so that the press-fit portions **202** are press-fitted into the press-fitted portions **112**.

As shown in FIG. **8** and FIG. **9**, the shell **200** of the embodiment comprises two hold downs **210**, a guide portion **220**, three ground spring portions **230**, and two ground portions **240**. The hold downs **210** are formed at both ends of the upper shell **200**U in the Y direction and extend downward (in the −Z direction). The guide portion **220** extends in the Y direction and is formed on the upper portion of the bottom shell **200**B. The ground spring portion **230** extends rearward and obliquely upward from the front end of the upper portion of the bottom shell **200**B (see FIG. **16**). With this structure, the ground spring portion **230** is displaceable in the Z direction. The ground portion **240** is projects downward and forward from the bottom shell **200**B. The ground portion **240** is positioned between the neighboring ground spring portions **230**.

As shown in FIG. **1**, the bottom end of the hold down **210** is connected with and fixed to the circuit board **900** by, for example, soldering. Similarly, the bottom of the ground portion **240** is connected with and fixed to the circuit board **900** by, for example, soldering so that the shell **200** is grounded. The ground portion **240** of the embodiment is fixed to the circuit board **900** in front of the connector **10** so that the connector **10** can withstand force exerted rearward (along the +X direction) when the connector **10** is mounted on the circuit board **900**.

As understood from FIG. **2**, FIG. **10** to FIG. **12**, the guide portion **220** is configured to guide the FPC **800** when the FPC **800** is inserted in the connector **10**. The guide portion **220** is positioned in front (in the −X direction) of the insertion opening **12** and extends in the Y direction. In detail, the guide portion **220** has an upper surface in parallel with the XY surface. In the Z direction, the upper surface of the guide portion **220** is on the same level as the bottom portion **116** of the inserted portion **114** (see FIG. **10**).

As shown in FIG. **10** and FIG. **13**, the ground spring portion **230** is positioned at the bottom of the insertion opening **12**. At least a part of the end portion of the ground spring portion **230** is positioned higher than the guide portion **220** in the Z direction.

As shown in FIG. **1**, the connector **10** comprises two attachments **250**. The attachments **250** are attached to the both sides of the housing **100** in the Y direction.

As shown in FIG. **1**. FIG. **8** and FIG. **9**, the attachment **250** of the embodiment is a part of the shell **200**. In detail, the attachments **250** are positioned on both end portions of the

shell **200** in the Y direction. However, the attachments **250** may be separated from the shell **200** unless the attachments **250** move in the X direction.

As shown in FIG. **11** to FIG. **13**, the attachment **250** has an upper attachment **252**, a lower attachment **254**, and a coupling portion **256**. The upper attachment **252** is positioned higher than the housing **100** while the lower attachment **254** is positioned lower than the housing **100**. Each of the upper attachment **252** and the lower attachment **254** has a plate-like shape in parallel with XY surface. The most part of the arms **130** of the housing **100** are covered with the upper attachment **252** and the lower attachment **254**. In detail, the upper attachment **252** is a part of the upper shell **200**U and covers the upper surface of the arm **130** (i.e. the upper surface of the housing **100**). The lower attachment **254** is a part of the bottom shell **200**B and covers the bottom surface of the arm **130**. The coupling portion **256** is positioned in front of the arm **130** and extends in the Z direction. The coupling portion **256** couples the upper attachment **252** with the lower attachment **254**.

As shown in FIG. **8** and FIG. **9**, according to the embodiment, the coupling portion **256** of the attachment **250** couples the upper shell **200**U and the bottom shell **200**B. The hold down **210** of the embodiment has an engaged hole **212**. The end portion of the lower attachment **254** in the +X direction extends in the +X direction and is inserted into the engaged hole **212** of the hold down **210**. In other words, the upper portion and the lower portion of the coupling portion **256** are fixed to the upper attachment **252** and the lower attachment **254**, respectively. Therefore, the coupling portion **256** can securely receive and withstand force exerted along the −X direction

As shown in FIG. **2**, the connecter **10** further comprises two lock portions **270**. The lock portions **270** are provided on both end portions of the housing **100** in the Y direction.

As shown in FIG. **2**, FIG. **8** and FIG. **9**, the lock portion **270** of the embodiment is a part of the shell **200**. In detail, the lock portion **270** is a part of the end portion of the shell **200** in the Y direction. In other words, the attachment **250** and the lock portion **270** are formed integrally with each other. However, the attachment **250** may be separated from the lock portion **270**. In this case, an end portion of a spring support portion **271** is held by the housing **100**.

As shown in FIG. **11** to FIG. **16**, the lock portion **270** has the spring support portion **271**, a spring portion **272**, and a locking lug **276**. The spring support portion **271** extends downward from the end portion of the shell **200** (i.e. the upper attachment **252**) and covers the outer side of the arm **130**. In other words, the bottom part of the spring support portion **271** is positioned lower than the arm **130** in the Z direction. The spring portion **272** is extend inward in the Y direction from the bottom end (i.e. the end portion in the −Z direction) of the spring support portion **271** so that the spring portion **272** is positioned between the arm **130** and the lower attachment **254** in the Z direction. In other words, the spring portion **272** is positioned between the upper attachment **252** and the lower attachment **254**. The locking lug **276** projects upward from the end portion of the spring portion **272**.

The spring portion **272** supports the locking lug **276** so as to be displaceable in the Z direction. The spring portion **272** of the embodiment extends from the spring support portion **271**. The length of the spring portion **272** is long in the Y direction. Therefore, the spring portion **272** can have sufficient elastic force even if the size of the connector **10** is not enlarged.

As shown in FIG. **11**, FIG. **14** and FIG. **15**, the spring portion **272** has a projection portion **274** projecting toward the coupling portion **256**. The front end of the projection portion **274** is close to the coupling portion **256**.

As shown in FIG. **11**, FIG. **12** and FIG. **16**, the locking lug **276** is in parallel with XZ surface. The locking lug **276** is formed with a force receiving portion **278** and an engagement portion **280**. The force receiving portion **278** is an oblique surface formed on the front surface (in the −X direction) of the locking lug **276** and is oblique to both the X direction and the Z direction. The engagement portion **280** is a rear (in the +X direction) surface of the locking lug **276**. The engagement portion **280** is perpendicular to the X direction.

As shown in FIG. **10**, FIG. **11** and FIG. **13**, the locking lug **276** extend upward (in the +Z direction) in the insertion opening **12** and the inserted portion **114**. The end portion of the locking lug **276** is higher than the guide portion **220**.

As understood from FIG. **1**, FIG. **4**, FIG. **11** and FIG. **12**, when the actuator **500** is positioned at the open position, the FPC **800** is inserted into the inserted portion **114** through the insertion opening **12**. In detail, the FPC **800** is guided by the arms **130** (the guide surfaces **132**) in the Y direction and guided by the guide portion **220** in the Z direction. When the FPC **800** is inserted to the insertion opening **12**, the FPC **800** pushes the ground spring portion **230** down (in the −Z direction), and the ground spring portion **230** is slightly displaced downward.

As shown in FIG. **17**, the FPC **800** moves rearward in the inserted portion **114** until the top end **800**T is abutted to the abutment portion **118**.

As shown in FIG. **18**, the actuator **500** is rotated from the open position to the close position in the state where the top end **800**T of the FPC **800** is brought into contact with or close to the abutment portion **118** (see FIG. **17** and FIG. **18**). With this operation, the supported portion **640** is lifted up in the +Z direction, and the contact portion **650** is displaced downward. The contact portion **650** is pushed toward the signal contact **820** of the FPC **800** so as to be electrically connected with the signal contact **820**. The FPC **800** is pushed also toward the bottom portion **116** and the guide portion **220** so that the ground spring portion **230** is displaced further downward. The ground contact **830** of the FPC **800** is sandwiched between the ground spring portion **230** and the contact portion **650** and electrically connected with the ground spring portion **230**. As explained above, the FPC **800** is electrically connected with the connector **10** so that the FPC **800** is electrically connected with the circuit board **900**.

As described above, the ground portion **240** is arranged between neighboring ground spring portions **230** in the Y direction and positioned near the ground spring portion **230** (see FIG. **8**). With this structure, the ground contact **830** of the FPC **800** is efficiently grounded.

As understood from FIG. **11** to FIG. **13**, the locking lug **276** is positioned an initial position (see FIG. **11**). When the FPC **800** is inserted into the inserted portion **114** and moved rearward (in the insertion direction: in the +X direction), the top end **800**T (see FIG. **6**) is brought into contact with the force receiving portion **278** of the locking lug **276**. When the FPC **800** is moved further rearward, the force receiving portion **278** receives force exerted downward from the FPC **800** and is displaced downward from the initial position. Therefore, the top end **800**T of the FPC **800** passes on the locking lug **276**. When the FPC **800** is moved rearward and brought into contact with or close to the abutment portion **118** (see FIG. **17**), the locking lug **276** is displaced upward and returns to the initial state (see FIG. **12**).

As understood from FIG. **4**, FIG. **11** and FIG. **12**, the FPC **800** is inserted in and electrically connected with the connector **10** (a connection state). When the FPC **800** positioned at the connection state is moved along an eject direction (i.e. −X direction) opposite to the insertion direction, the engagement portion **280** of the locking lug **276** engages the engaged portion **812** of the FPC **800** so that and the engagement portion **280** prevents the engaged portion **812** from further

moving along the eject direction. Thus, the connection state between the connector **10** and the FPC **800** is locked (maintained).

Moreover, according to the embodiment, the lock portion **270** (the spring portion **272**) is positioned rearward of the coupling portion **256**. When the FPC **800** positioned at the connection state is moved along the eject direction by force, the spring portion **272** is displacing forward (in the −X direction), and the projection portion **274** is brought into contact with the coupling portion **256**. The coupling portion **256** prevents an excessive displacement (movement) of the spring portion **272** toward the eject direction. In the embodiment, the lock portion **270** can be strengthened, and damage of the lock portion **270** is prevented. Moreover, the attachment **250** is formed integrally with the shell **200** so that force exerted to the FPC **800** along the −X direction can be received by the whole part of the attachment **250** (the whole part of the shell **200** fixed on the circuit board **900**). Therefore, the connection state between the connector **10** and the FPC **800** is securely maintained and the damage of the lock portion **270** is prevented.

As shown in FIG. **10** and FIG. **11**, the insertion opening **12** opens forward and upward (in the −X direction and the +Z direction). In detail, a part of the bottom portion **116** and the guide portion **220** is visible when seen along the Z direction. Therefore, the FPC **800** can be easily inserted into the connector **10** obliquely (see FIG. **12**).

As shown in FIG. **4**, FIG. **5** and FIG. **12**, the locking lug **276** is visible along the Z direction. Therefore, the connection state between the connector **10** and FPC **800** is visible from above the connector **10**. The connection between the FPC **800** and the connector **10** is released by pushing the locking lug **276** down.

The mount object of the embodiment is the circuit board. However, the mount object is not limited thereto. The present invention can be applied to a connector which is not mounted on the circuit board.

The connection object is not limited to the sheet-like connection object such as FPC or FFC (Flexible Flat Cable). When the connection object is thick, the locked portion of the connection object may be a recess.

Moreover, the hold down, the guide portion, the ground spring portion, and the ground portion may be separated from each other.

The present application is based on a Japanese patent application of JP2011-259404 filed before the Japan Patent Office on Nov. 28, 2011, the contents of which are incorporated herein by reference.

While there has been described what is believed to be the preferred embodiment of the invention, those skilled in the art will recognize that other and further modifications may be made thereto without departing from the spirit of the invention, and it is intended to claim all such embodiments that fall within the true scope of the invention.

What is claimed is:

1. A connector connectable with a connection object having a locked portion, the connection object being insertable into the connector from a front of the connector in an insertion direction, and the locked portion having an engaged portion, the connector comprising:

a housing;

an attachment attached to the housing, wherein the attachment comprises an upper attachment, a lower attachment, and a coupling portion, the upper attachment is positioned above the housing, the lower attachment is positioned below the housing, and the coupling portion couples the upper attachment and the lower attachment; and

a lock portion comprising a locking lug and a spring portion, wherein the locking lug is positioned rearward of the coupling portion in the insertion direction, the locking lug has an engagement portion, the spring portion is positioned between the upper attachment and the lower attachment, and the spring portion supports the locking lug such that the locking lug is displaceable in a vertical direction perpendicular to the insertion direction;

wherein when the connection object is connected with the connector and moved in an eject direction that is opposite to the insertion direction, the engagement portion engages with the engaged portion such that the engagement portion prevents the engaged portion from further moving along the eject direction.

2. The connector according to claim **1**, wherein the housing is provided with an arm which guides the connection object when the connection object is inserted into the connector, the arm extends in the eject direction, and the spring portion is positioned between the arm and the lower attachment in the vertical direction.

3. The connector according to claim **1**, wherein the spring portion is formed with a projection portion projecting toward the coupling portion.

4. The connector according to claim **1**, further comprising a shell held by the housing, wherein the attachment is a part of the shell, and the upper attachment covers an upper surface of the housing.

5. The connector according to claim **1**, wherein the attachment and the lock portion are formed integrally with each other.

6. The connector according to claim **5**, wherein the spring portion extends from the upper attachment.

7. The connector according to claim **4**, wherein the housing is formed with a press-fitted portion, and the shell comprises a press-fit portion and is attached to the housing by press-fitting the press-fit portion into the press-fitted portion.

8. The connector according to claim **1**, wherein the connection object has a sheet-like shape; and

wherein the connector further comprises:

an insertion opening into which the connection object is insertable, the insertion opening extending in a width direction perpendicular to the insertion direction and the vertical direction; and

a guide portion positioned in front of the insertion opening and extending in the width direction, the guide portion guiding the connection object when the connection object is inserted into the connector.

9. The connector according to claim **8**, further comprising a ground spring portion positioned at a bottom part of the insertion opening and being displaceable in the vertical direction, wherein at least a part of the ground spring portion is positioned above the guide portion.

10. The connector according to claim **1**, wherein the connector is mounted on a mount object and further comprises a ground portion connected with the mount object.

11. The connector according to claim **1**, wherein the locking lug is arranged so as to be visible when seen along the vertical direction.

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